TRANSACTIONS

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED ONE

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirtieth Annual Meeting

JULY 19 AND 20, 1901.

Headquarters of the Meeting, Hotel Pfister, Milwaukee, Wisconsin.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1901.

Officers for 1901-1902.

President, - - - GENERAL E. E. BRYANT, Madison, Wis.
Vice-President, - - EUGENE G. BLACKFORD, New York City.
Recording Secretary, - GEORGE F. PEABODY, Appleton, Wis.
Corresponding Secretary, JOHN E. GUNCKEL, Toledo, Ohio.
Treasurer, - - - C. W. WILLARD, Westerly, R. I.

EXECUTIVE COMMITTEE.

JOHN W. TITCOMB, *Chairman*, St. Johnsbury, Vt.

GEORGE T. MATHEWSON, Thompsonville, Conn.
I. H. DUNLAP, Washington, D. C.
HENRY O'MALLEY, Baker, Wash.
W. H. BOARDMAN, Central Falls, R. I.
J. J. STRANAHAN, Bullochville, Ga.

NOTE.

On account of the short time at the disposal of the convention, it was impossible to discuss every paper which was contributed. The text of the various papers and discussions will be found in Part Two of the Transactions.

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PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Friday, July 19, 1901.

Convention called to order at 10:30 a. m., by the President, Mr. F. B. Dickerson, of Detroit, Mich.

During the several sessions the following gentlemen were elected to membership in the society:

Name.	Address.
Ainsworth, G. G	Leadville, Col.
Babcock, John P	San Francisco, Cal.
Baldwin, O. N	San Marcos, Tex.
Beeman, Henry W	New Preston, Conn.
Bennett, Chas	Woonsocket, R. I.
Blakeslee, T. J	New York City.
Bross, John L	Mill Creek, Mich.
Bush, C. P	Columbus, Ga.
Clark, Fred	Mill Creek, Mich.
Cooper, E. A	Cold Spring Harbor, N. Y.
Davis, E. A	Bethel, Vt.
Dean, Herbert D	Neosho, Mo.
DeNyse, Washington I	Gravesend Beach, N. Y.
Frook, John E	Paris, Mich.
Fullerton, Samuel F	St. Paul, Minn.
Gilmore, Col. Chas	Swanton, Vt.
Gortz, A. F	Chicago, Ill.
Hulff, J. H	Norfolk, Neb.
Jones, Col. James E	New York, N. Y.
Kashiwa, A. M	New York, N. Y.
Keller, H. N	Santa Monica, Cal.
Leary, John L	San Marcos, Tex.
Mershon, W. B	Saginaw, Mich.
Mitchell, Prof. Irving M	Milwaukee, Wis.

Mitchell, John A. . . . . Columbus, Ga.
Neal, John R. . . . . Boston, Mass.
Norman, R. M. . . . . Columbus, Ga.
Parker, W. H. . . . . Lac la Peche, Quebec, Canada.
Pike, Robert G. . . . . Middletown, Conn.
Sampson, E. R. . . . . New York, N. Y.
Sanborn, F. G. . . . . San Francisco. Cal.
Scarborough, L. A. . . . . Columbus, Ga.
Schley, Dr. F. V. . . . . Columbus, Ga.
Schulte, John A. . . . . Havana, Ill.
Singleton, James H. . . . . Woonsocket, R. I.
Smith, Henry D. . . . . Appleton, Wis.
Smith, Jay. . . . . Boston, Mass.
Snyder, Dr. F. B. . . . . Ashtabula, Ohio.
Spencer, L. B. . . . . New York, N. Y.
Springer, F. H. . . . . Columbus, Ga.
Suthers, Frank. . . . . Madison, Wis.
Townsend, Chas. H. . . . . Washington, D. C.
Turner, J. C. . . . . Columbus, Ga.
Wentworth, Edwin. . . . . Nashua, N. H.
Wheeler, Chas. Stetson. . . . . San Francisco. Cal.
Wisner, J. Nelson, Jr. Washington, D. C.
Woodruff, C. B. . . . . Columbus, Ga.

Honorary membership.

Peck, Hon. Geo. W. . . . . Milwaukee, Wis.

The President: It affords me much pleasure to greet the members of this Association on this our 30th annual gathering. I had hoped however to see a great many more present, but understand that there will be quite a good many more here this afternoon. I must confess that I have been so very busy during the past year that I have not done a very great deal of work myself; the secretary however has done a great deal.

We are assembled for educational purposes with as much in the line of social intercourse and good fellowship as we can crowd in on the side. I am afraid however that we will not have an opportunity to crowd in very much "on the side," inasmuch as our gathering a year ago must have been composed largely of Seventh Day Adventists, as they set this meeting so that if we consume the three days we would have to work on Sunday, the same as they do. The consequences are that this year we will have to crowd three days' work into two or desecrate the Sabbath; so we must get right down to business and hurry along.

I understand that we have two illustrated lectures which of course will be very interesting, and if it is possible to have both of those tonight we will do so, inasmuch as it is desired to go to the Bayfield Hatchery tomorrow on the early evening train, and therefore there will be no opportunity for any session tomorrow night.

I love to fish as well as any man living. In fact, for me this form of recreation ranks above all others and claims all of the time I can possibly steal from a very busy life to devote to real and unalloyed pleasure. I would like to be wading and whipping a good trout stream this very moment; or be in camp near the banks, under the inspiration of the woods and God's pure air, and within sight of familiar pools and bends where the skillful dropping of a fly would not pass unrewarded. In the midst of such surroundings, gentlemen—and if any of you haven't been right there, you have missed the best opportunity of your life—I might warm up and talk of fish and fishing by the hour, of the big trout I have landed and of the still bigger ones that got away, but time forbids.

A word as to the growth of our society and the qualifications for membership. It seems to me that our membership list should increase far more rapidly. We should have one hundred members or even one thousand where we now have but one. It has occurred to me that through lack of example or proper encouragement, we have unintentionally barred out a large class who are eminently qualified for admission, and I hereby appoint every member a committee of one to advertise the fact that all amateur and professional fish liars are eligible to membership. No convention hall in the country would hold the delegates if we could but bring into the fold all who are gifted in this direction and practice the art. Indeed, from some things I have heard since coming here, there is a lot of mighty good material in Milwaukee, and we should at least double our membership right here.

On my way over, the thought occurred to me that, although we are now few in numbers, this organization is destined to grow great and powerful. We are the pioneers in a movement that must inevitably exert a far-reaching influence and become an important factor in the solution of the greatest economic problem that must sooner or later confront mankind, namely, that of providing an abundant and unfailing source of food supply. And why? In this and nearly all countries we find that practically all fertile lands, lands that yield their fullest fruitage merely by tickling the soil, are occupied. Increased food production from this direction must come very largely through fertilization, irrigation, and more thorough and scientific methods of farming.

But we have an immense area of inland and outlying waters, constituting a water farm of such vast proportions and possibilities, that it can be cultivated only by states and nations. This great public farm, this vast public estate, is today very largely in a state of nature, uncultivated, unexplored, unexploited. True, great progress in the science and art of producing water life has been made in this country, greater, in fact, than by all other nations combined, resulting in the creation of millions of dollars in food wealth, yet we are only at the threshold of the possibilities in this direction. And it is the mission of this society collectively, as it should be of every member individually, to aid in discovering and pointing out the way to so cultivate and crop this vast water farm as to develop its illimitable resources to the greatest practicable limit. We are charged with a high responsibility, gentlemen, but we are engaged in a noble cause, and if we are but true to our mission, each contributing his mite towards the solution of the complex problem before us, we shall be true to humanity, and millions yet unborn will rise up to bless the name and the founders and pioneers of the American Fisheries Society.

(Applause).

We will vary our program as we have really less than two days in which to do the work of three, and will therefore have to rush matters with all possible speed. With the permission of those present I will forego the appointment of committees until this afternoon, as I understand there are more members to arrive about noon. Just exactly what the program is as regards the desires of the Wisconsin Fish Commission, I am not fully informed; the only thing I know of is their generous invitation, without expense, to take this body of gentlemen to the Bayfield Hatchery; I understand they have furnished a private car to be attached to the regular train. Every one who can should avail himself of this invitation and visit the Bayfield Hatchery, which is a most excellent one in every respect.

A motion was carried that the president appoint a temporary treasurer to take the place of the treasurer in his absence.

The president appointed Mr. I. H. Dunlap of the United States Fish Commission, Washington, D. C., as temporary treasurer.

The President: I will appoint as a committee on new members, to report as soon as possible, Mr. Frank N. Clark, of Northville, Mich., Mr. George F. Peabody, of Appleton, Wis., and Mr. I. H. Dunlap.

General E. E. Bryant, of Madison, then read a paper on the subject of "The Power of the State to Regulate Fisheries and the Taking of Fish."

Mr. Henry T. Root, Providence, R. I.: That is a paper which I think should be published by the society and distributed largely to the members, without waiting for it to appear in our regular transactions. It is the most valuable paper probably ever prepared on this subject, and we ought to have it printed in such quantities that we can lay it before different legislators. I should like to bring up a motion that will cover that point.

Mr. Titcomb: I would like to put it in as an appendix to our state report if we could get it.

The President: It could be printed readily and cheaply by the society.

Mr. Root: I move that a thousand copies of the paper read by Gen. Bryant be printed at the expense of the society and distributed to the members.

The President: Our commission will print five thousand and charge any other state that wants them a proportionate rate and it won't cost the society anything. It ought not to cost over two dollars a thousand to print the paper.

It was moved by Mr. Henry T. Root that the president, Mr.

Dickerson, be requested to print 5,000 copies of General Bryant's paper and to supply them to other commissions at cost price.

Motion seconded and unanimously carried.

Dr. J. C. Parker, of Grand Rapids, Mich., then read a paper on the subject of "Man as a Controlling Factor in Aquatic Life."

Mr. John E. Gunckel, of Toledo, O., then read a paper entitled, "The Index."

The President: There will be two lectures this evening, commencing at 8 o'clock, one by Mr. Titcomb, illustrating propagation of fish, and the other by Mr. Townsend, on deep sea soundings. These lectures will be illustrated with lantern slides and the public are invited to attend them.

Recess until 2:30 p. m., same day and place.

AFTERNOON SESSION, JULY 19.

Society called to order by the president, at 2:55.

The President: We will first hear the report of the committee on new members.

Mr. Clark: The committee have had these names under consideration, which have all been recommended by members of the society. They are all good men and true, and we are glad to have them join.

(List of new members read, whose names are published at the beginning of the printed proceedings, together with those of all others admitted during the several sessions).

They have all paid the annual dues of $1.00 to the secretary and your committee recommend them for membership in this society and that they be elected as members of this society with all its privileges.

Report adopted and members elected.

Moved, seconded and unanimously carried that the chair appoint the usual committees.

The President: I will appoint as the committee on nominations: George F. Peabody, Henry T. Root, J. J. Hogan, Frank N. Clark and John W. Titcomb.

Auditing committee: I. H. Dunlap, D. Lydell and W. F. Hubbard.

Committee on time and place of next meeting: J. E. Gunckel, G. M. Brown and W. H. Boardman.

Committee on resolutions: General E. E. Bryant, Charles H. Townsend and S. W. Downing.

Report of treasurer referred to auditing committee.

The President: The committees will report tomorrow morning.

You will remember that there was a memorial committee appointed to consider the plan of erecting a memorial to Professor Baird, and the chairman of that committee being unavoidably absent has submitted his report and I will request Mr. Clark to read it.

Mr. Clark then read the following:

REPORT OF BAIRD MEMORIAL COMMITTEE.

Woods Hole, Mass., July 13, 1901.

To the President,

American Fisheries Society,

Milwaukee, Wis.

Sir:—As chairman of the Baird memorial committee appointed at the last meeting of the society, I have the honor to make the following brief report:

Shortly after the adjournment of the society, the committee set about soliciting subscriptions, by means of letters and personal appeals, and invited small contributions from many rather than large contributions from a few. The plan to erect at Woods Hole a memorial to Professor Baird was favorably noticed in the press and unqualifiedly endorsed by the fishing and scientific public.

From a statement furnished by the treasurer, Hon. E. G. Blackford, it appears that the total amount subscribed up to July 15, 1901, was $503.25, of which $473.25 had been paid and $30.00 remained unpaid. This sum has been contributed in small amounts by many persons, the largest individual subscriptions being $20.00.

At a called meeting of the committee held at Washington on February 3, it was decided, after considering the probable amount of the subscriptions, that the proposed memorial take the form of a natural boulder with suitably inscribed artistic bronze tablet; and full powers for determining the details and proceeding with the erection of the monument were delegated to a sub-committee consisting of the chairman and treasurer.

Various unavoidable matters have delayed the completion of the monument more than the committee anticipated; but it can now be stated that the plans for the monument have been completed, the placing of the stone will soon be begun, and the memorial will be duly consummated during the present summer.

Respectfully submitted,

H. M. SMITH.

A motion was then made, seconded and unanimously carried that the report be received and referred to committee on resolutions.

General Bryant: Is there any member of the memorial committee present to whom we can hand contributions?

The President: Mr. Peabody and Mr. Clark are members of the committee and are present.

I think it will be well, in view of the limited time we have, to first listen to those papers furnished by members who are here themselves to read them, and then we can take up those papers which are to be read by others, because there are undoubtedly a number of them that we will simply have to print in the proceedings, so that if there is no objection we will go ahead and call on those who are present first to read their papers.

The Wisconsin commission would like to know exactly how many gentlemen are going tomorrow night to Bayfield. The transportation is furnished and those who go will simply pay for their sleeper. The train will return Monday morning and will reach Chicago at 9 o'clock. The Bayfield Hatchery of course is one of the latest and most up-to-date hatcheries in the country, and is well worth a visit.

Professor Marsh then read a paper on the subject of "Brook Trout Disease."

General Bryant: We have among us now ex-Governor George W. Peck, of Wisconsin. He is a friend of the fish and game commission, and I would like to suspend our discussion for a moment, if this paper is concluded, and hear a few words from him.

The President: He is a bad boy and something of a fisherman himself, and that is why I know he is a bad boy. He said to me this morning, "Dickerson, did you ever know of a fish called the bee-fish?" I said no, I had never heard of him, and he went on to tell about fishing off the dock down here at Milwaukee and he said he caught one of those bee-fish and it weighed seventeen pounds and when he got him on the dock and cut him open he found a hive of bees in him and thirty-two pounds of honey. I think he is eligible.

(Great laughter and applause).

Ex-Governor Peck: I had supposed that the Fish Commissioners were the ones that told those stories. Before Fish Commissions were appointed the laymen who do the fishing were supposed to tell those remarkable stories, but as I understand it, the appointment of these Fish Commisioners was made for the purpose of having them start out and tell the stories that the people might adopt. That certainly was my idea in appointing two of the most distinguished citizens of Wisconsin as Fish Commissioners. (Laughter and applause).

I have been interested in fish since I was seven years old. At that time I was provided with a three board boat that would hold a barrel of water to wade in, and I had my trousers rolled up, what there was of them, and I caught the sunfish and the bullhead. That was my first experience, and I have great confidence in the bullhead because he never goes back on the fisherman. When a bullhead bites you have got him; you haven't got to fool away any time with a three ounce rod in poling him all over the lake or river to get him into your boat. When he begins business and swallows the bait it goes clear down to the bottom and the best way is to cut it out from the other side. (Laughter). The bullhead is the best thing that a young man can begin on, because it teaches him that the fisherman is invulnerable and the bullhead is a fool. But the bullhead is good eating. After that I caught all kinds of fish that I could; I never worked any when I could help it and never shall (laughter and applause). I believe that it is the duty of every citizen of Wisconsin particularly to go fishing all of the time that he can. Business is something that some have to attend to, but when men get to be 50 or

60 years old the business should be attended to by their sons, or their sons-in-law, and men should be allowed to go fishing.

Not many years ago I advocated publicly in the newspapers that when old men were sent to asylums or poor houses or soldiers' homes, those institutions ought to be located upon the bank of some lake or river where there is fishing, and every old man after he gets to be 60 should be provided with a boat and all the fishing tackle that he wants, and that the city or the county that entertains him as a pauper or in any other capacity, should give him the bait, and if it is necessary, if he has had his finger shot off, somebody should be detailed to put the bait on the hook for him. That is the way I feel about the old men. Old women can get along any way—all they want is to eat the fish.

I presume many of you do not know much about Wisconsin except what you have been told by our local manufacturers. If you could see a map of the northern part of the state you would think that Wisconsin was one case of smallpox from the number of little lakes dotted all over it; and these clear lakes, some of them not more than half a mile across, are full of the best fish in the world. The waters are deep, blue, perfect and clean, and you ought to go into the northern part of the state for a month and look this business over, look at the fish hatcheries and also look at what nature has done—and nature will keep it up.

You have got a great responsibility. It has sometimes seemed to me that it was wrong to take a female fish, and take all there is in her out and let the Fish Commissioners make it into minnows. I don't know how they do it. I sometimes thought I would go and examine and see how they take this spawn that is no good in the fish, get in their work on it and make it so that it is good. (Laughter and applause). At one time I thought when I appointed some of these Fish Commissioners and we provided through Speaker Hogan a car that would carry fish all over the world, that some time I might get in there and look it over and find out how it was done. I hope that I may do so even yet and that I may be able to work it in in my own business (laughter and applause).

When I read that the Fish Commissioners of a state plant millions upon millions of fish in its waters, I feel as though they are responsible for the millions and millions of lies that will be told by the fishermen after the fish get big enough to be caught. But a good commissioner does not care how much anybody else lies as long as he is truly good and can tell the truth himself.

I hope that you will visit as much of the state as possible before you go, you will find much good fishing and you will become convinced that Wisconsin is as grand a state as there is in the Union. We raise everything in Wisconsin that is raised anywhere in the world, except h—l. (Laughter and applause). Some of you can do that better than we can. But Wisconsin has got everything from the south line to Lake Superior that the people need for a good living. We could build a fence around the state of Wisconsin and never a citizen go outside of that fence, and nobody be allowed to come in from the outside, and we would all get so fat and so happy that you would pay an admission fee to come and look over the fence and see the good people of the State of Wisconsin. (Laughter). We trust that you may come often to see us, and I will say that I will detail my Fish Commission which is here and which I am as proud of as I am of the appointment of any individuals during my term of office, to greet you and show you everything there is and give you everything that you need to be happy. (Applause).

Mr. Bower: I move that Ex-Governor George W. Peck be elected an honorary member of this society. Motion seconded and unanimously carried.

The President: We shall expect you to be present at our next meeting.

Ex-Governor Peck: I shall if I can. I shall be glad to render any assistance that I can, as long as I live, to the Fish Commission of this country.

The President: While at first it was thought best only to have papers prepared by members present read, yet we have a paper in the same line as that of the preceding paper written by one of the oldest employes of the United States Fish Commission, and it seems to me that this is an opportune time to hear that particular paper. So if there is no objection we will vary the routine a little and I will ask Mr. Bower to read Mr. Charles G. Atkins' paper on the subject of the "Study of Fish Diseases."

The paper was then read by the secretary.

General Bryant here took the chair.

Mr. Sykes then read a paper by Mr. Nevin on the subject of "Muscallonge."

The President: Professor Starr of the Wisconsin Commission has a beautiful yacht and he tenders us a ride on the lake at 5 o'clock this afternoon.

(Invitation accepted).

Motion made at 4:45 p. m. to adjourn until 8 p. m. in the banquet room.

Motion carried.

EVENING SESSION, BANQUET ROOM, 8 O'CLOCK.

Lectures delivered with illustrated lantern slides by Mr. C. H. Townsend on "Deep Sea Exploration," and Mr. J. W. Titcomb on the subject of the "Propagation of Fish."

An adjournment was then taken until July 20th, 10 a. m. in the club room.

Saturday, July 20, 1901.

MORNING SESSION, 10 O'CLOCK.

An invitation was accepted for a carriage ride around the city at 4:30 p. m.

The committee on location and time presented the following report:

REPORT OF COMMITTEE ON LOCATION AND TIME.

After carefully considering the invitations from the several cities we respectfully suggest that the next annual meeting be held at Put-in-Bay (Lake Erie) Ohio, on Tuesday, Wednesday and Thursday of the first week in August, 1902, and that the meeting be called to order at 2 p. m. Tuesday. It is further suggested that the place and time be printed on the letter heads usually furnished by the society.

J. E. GUNCKEL,
G. M. BROWN,
W. H. BOARDMAN.

Report received, accepted and unanimously adopted.

Report of committee on nomination of officers, presented by Mr. Peabody:

REPORT OF COMMITTEE ON NOMINATIONS.

The committee on nominations beg to report, nominating the following officers of the society for the ensuing year:

President, General E. E. Bryant, Madison, Wis.

Vice President, Eugene G. Blackford, New York.

Recording Secretary, George F. Peabody, Appleton, Wis.

Corresponding Secretary, John E. Gunckel, Toledo, O.

Treasurer, C. W. Willard, Westerly, R. I.

Chairman Executive Committee, John W. Titcomb, St. Johnsbury, Vt.

Members of Executive Committee: George T. Mathewson, Thompsonville, Conn. I. H. Dunlap, Washington, D. C. Henry O'Malley, Baker, Wash. W. H. Boardman, Central Falls, R. I. J. J. Stranahan, Bullochville, Ga.

Report unanimously accepted, adopted and nominees declared duly elected.

General Bryant, president-elect was called on for a speech.

General Bryant: In the language of our daughters when they are proposed to, I say, "This is so sudden." I had not thought of anything of the kind, but I extend to you my heartiest thanks for your kind appreciation and assure you that in so far as in me lies I will endeavor to serve the society faithfully and promote its interests to the best of my ability. The rest of the oath of office you will consider implied.

The subject of fish culture with me is of necessity more a by-study than a pursuit to which I can give my undivided devotion, but I am very much like old Ethan Allen, of Green Mountain memory, who said that of "all the Lord's cattle on the thousand hills he best preferred soldiers for companions." I can paraphrase that honestly and say that of all the Lord's cattle on a thousand hills I best enjoy the society of men engaged in fisheries and fish culture, and can co-work with them in my feeble way with hearty satisfaction. It is the tendency of human nature, we know, for every man to exalt his own vocation. That idea comes down to us from the classics in the old adage, "There is nothing like leather." The story is told that when an ancient city was threatened with attack from the enemy, they called a counsel of all the people of the city to consider how they would best fortify it. The stone masons said with a sneer that of course they must use stone; the brickmakers said that by laying brick walls thick enough they would better stand the battering ram than stone; the lumberman insisted that a strong system of stockades would be built the quickest and would best withstand attack. They called up the old tanner and he said, "Gentlemen, there is nothing like leather; you just peg down sole leather walls around this city and all the battering rams on earth cannot batter them down." Every man exalts his own vocation, but we who are engaged in fish culture are in no danger of overdoing. The work that we are doing is so beneficial to mankind, its possibilities so great, its power of usefulness to mankind so unlimited, that we may well exercise this failing of human nature and give to our pursuit due honor. It has been said that the man who makes two blades of grass to grow where one had grown before, is a benefactor of mankind. If that be so how much more is it so where one makes an hundred food-fish to grow where nature makes only one to grow.

You recollect our old friend Sam Weller, one of the most delightful characters that Dickens ever drew, having assisted a young couple to elope, who were very enxious to marry but met with domestic opposition, said, when he was complimented on the part he had taken in the matter, "Well, I only assisted nater." (Laughter). Now we are assisting nature in this work in one of her weak spots. We are taking up her work and producing vastly greater results than she could produce herself. That is our function in this great work, to assist nature and to enable her to produce blessings for mankind an hundred fold or a thousand fold, where left to herself she could give perhaps but five or ten fold. Is not that so, Brother Titcomb?

Mr. Titcomb: That is right.

General Bryant: Let us go on then with this work, let us maintain this society. This society may not present such a showing in numbers at its conventions as the Elks, the Modern Woodmen, or other fraternal societies, but I can liken it best to those old bottles of wine that have grown few and scarce in a cellar, of some ancient vintage, rich, mellow, delicious and nourishing—but the bottles are few. We have a small membership in attendance, but a large membership in sympathy, a large circle of readers who read with interest the papers that are submitted here. Let us keep up this work. Let us make the report of this society year by year, better and better. Let us dig deeper into all the problems that perplex us. I hope a hundred years from now the American Society of Fisheries will be presenting its annual report and turn back reverently and gratefully to the sterling spirits who worked for it in its youth and its earlier manhood. So far as I can help in my feeble way I promise you my best endeavors. (Applause).

Mr. Gunckel: As I am compelled to take my leave now, I wish to take the liberty, not being a scientist in the art of fish culture, to thank the members for their kindness and personal attention to a common, every day, worm fisherman. I have been a member of the society for eleven years and seldom miss a meeting. Near my home in Toledo some time ago a 21 pound small mouthed bass was caught and turned over to Mr. Downing, of Put-in-Bay, the fish commissioner of the state of Ohio, who is here present. When this fish was taken to him, he opened it and found one gallon of small mouthed black bass eggs. He took those eggs over to his hatchery; he took from his laboratory different bottles of milt procured from various kinds of fishes; he poured this milt in sections over the eggs that he had and in this manner produced pickerel, white-fish, black bass and sun-fish. When you come to Put-in-Bay you can see that hatchery, and I hope to be there to further continue truthful fish stories. (Applause).

Mr. Peabody: I am informed by Mr. Gunckel that his wife secured six gold fish during the present hot season and put them into a globe bowl of water, and they perspired so that the water ran over the edge of the bowl and spoiled the carpet. (Laughter).

The report of the treasurer was then read by Mr. Dunlap.

REPORT OF THE TREASURER.

To the American Fisheries Society.

Gentlemen:—I hereby submit my annual report as treasurer, from July 19, 1900, to July 18, 1901.

RECEIPTS.

July 19, 1900.	To balance in treasury	$216.34
	Yearly dues and fees	260.00
	One life membership fee	15.00
	Reports sold	4.75
	Interest on funds deposited in bank	2.71
		$498.80

DISBURSEMENTS.

July, 1900.	Stenographer, Woods Hole meeting	$ 30.00
	L. D. Huntington, stamps, etc	.32
Aug. 10,	Express on treasurer's books	.70
21,	J. W. Titcomb, sundries, Woods Hole meeting	7.17
	H. J. Rice, balance due on work	54.37
29,	Stamps and envelopes	4.50
Sept. 4,	Receipt book	2.89
Nov. 30,	Stamps and envelopes	4.65
Dec. 18,	Speaker Printing Co., printing, etc	162.20
	Richmond & Backus, envelopes	4.00
	S. Bower, secretary, stamps, etc	30.61
May 10, 1901.	Receipts, stamps and envelopes	2.80
July 12,	Speaker Printing Co., circulars, etc	15.00
	S. Bower, secretary, stamps, etc	13.30
15,	Stamps, envelopes, etc	1.20
		$333.71
Balance on hand		165.09
		$498.80

Depository of Funds,
Manufacturers' Trust Co., of Providence, R. I.,
drawing interest at 2 per cent. subject to check.

CHAS. W. WILLARD,
Treasurer.

July 15, 1901.

REPORT OF AUDITING COMMITTEE.

Mr. Dunlap: The auditing committee has been over the accounts and finds vouchers except for immaterial expenditures and that the accounts are correct.

Report of treasurer accepted.

Report of auditing committe accepted and adopted.

Mr. Clark: I desire to call attention to the fact that for some reason the balance this year is less than it was last year. I presume that our expenditures have been greater.

Mr. Titcomb: A year ago we made an unusual effort to get in back dues. Members who had not paid for ten or fifteen years were written to, and we got a good many of them to pay up, and for that reason I think our receipts that year were larger than they were this year.

Mr. Clark: I notice in the report of the treasurer that there was one life membership taken out and paid for. I believe that we took action on the subject of life memberships last year, but I think some plan should be adopted so that the life member may have some sort of certificate to show his membership.

The President: I will ask Mr. Boardman to read Professor A. D. Mead's paper on "Experiments in Lobster Culture."

Mr. Boardman: This paper by Dr. Mead, of Rhode Island, deals exclusively with lobsters, and may not be very interesting to those who are not engaged in that culture. Dr. Mead wished me to express his regret at his inability to be present at the meeting, but his work is especially heavy at this time of the year and it was impossible for him to come.

Dr. Mead's paper was then read.

A paper on the subject of "Practical Hints on Fish Culture," by Dr. James A. Henshall, was next read by the president.

Mr. Clark then read a paper entitled, "The Quality of the Water a Factor in Rearing Trout Fry," by Mr. C. C. Wood.

The President: I wish to announce to you all a new arrival, Mr. Carp—I mean Mr. Bartlett. (Laughter). (Mr. Bartlett was invited to address the society).

Dr. S. P. Bartlett, Quincy, Ill.: I thank you.

Mr. Townsend: There is no fish but carp and Bartlett is its prophet.

Dr. Bartlett then addressed the convention.

A motion was made, seconded and unanimously carried that Dr. Bartlett be requested to prepare a paper on the subject of carp, with instructions for cooking him.

An adjournment was here taken until 2:30 p. m., same day and place.

AFTERNOON SESSION, 2:30 O'CLOCK.

Meeting called to order by the president.

Mr. Bower: During the past year I have had considerable correspondence with Mr. A. H. Dinsmore, a member of this society, formerly of the state of Maine, but recently transferred to South Dakota. He is an employe of the United States Fish Commission, and I have rather encouraged him in the collection of a number of views, and he expected to be present at this meeting and give us an illustrated talk similar to those that we were entertained with last night, but at the last moment he found that he could not come. He prepared a large number of slides and has also sent in an introduction to his lecture, and has gone to a good deal of trouble and some little expense in the matter, and it seems to me we ought to recognize it in some way, especially as he has been encouraged by the official representative of the society and he is certainly entitled to a vote of thanks.

Since Mr. Dinsmore has been transferred to his new field in South Dakota, I have had a number of interesting letters from him. He writes me that he has run across a great many interesting things of a fishing nature out there, that the artificial propagation of fish has been remarkably successful, that in fact most of the fish they catch are salmon yanked from irrigation ditches, and that it is a common sight to see men and women fishing through the cracks in the sidewalk all through the city. (Great laughter and applause).

I will now with the permission of the society read a letter from Mr. Nat. H. Cohen, president of the Illinois Fish Commission, regarding the amended fish law which went into effect in Illinois July 1, 1901.

Mr. Cohen's letter read.

General Bryant, chairman of committee on resolutions, then presented the following report of committee on resolutions:

REPORT OF COMMITTEE ON RESOLUTIONS.

Resolved: That the thanks of the society are heartily extended to the Chicago & Northwestern Railway Company and the Wisconsin Central Railway Company, for courtesies extended in enabling the members of the society to visit Bayfield:

To the proprietor and management of the Hotel Pfister for facilities furnished for holding our meetings and lectures:

To the several Milwaukee dailies for their kindly mention and full reports of our proceedings:

To Mr. J. W. Titcomb and Mr. C. H. Townsend for their very interesting and instructive lectures; and to Mr. A. H. Dinsmore for the excellent slides sent by him to illustrate fishing scenery, etc., on the lines of the Maine Central and B. & A. R. R. in Maine:

To Mr. Wm. J. Starr, for the delightful sail on the good yacht Rosamond:

That we extend our thanks to Mr. A. D. Mead, Mr. W. T. Thompson, N. H. Cohen, Livingston Stone, B. W. James, A. H. Dinsmore, C. C. Wood and C. G. Atkins, for the valuable and interesting papers submitted by them, and express our regret that the several writers could not be present to take part in the discussion.

That the thanks of the society are extended to Mr. Bower, secretary, for his able conduct of the duties of his office, and to all the various out-going officers of the society. We would be very glad, if we felt that the revenues would warrant it, to suggest compensation to Mr. Bower for the trouble and pains he has taken in the conduct of his office, but being somewhat frightened at the state of the exchequer we have not included such a recommendation in our resolutions. We would be very happy if it could be otherwise.

The committee report back the resolution relating to the Baird memorial and recommend the adoption of the following resolution, that the thanks of the society be extended to the committee having that matter in charge for their efforts in that behalf, and that the members of the society are urged individually to contribute the sum necessary to complete the work.

We would suggest that any other persons to whom we ought to extend a recognition of thanks, can have their names inserted by the secretary.

Report accepted and adopted, to be printed in the transactions.

The Secretary: I move that the introductory part of Mr. Dinsmore's lecture, which describes the wild-life scenes and portions of Maine where he collected this material, being a brief and very interesting description, be printed in the minutes of this society's proceedings.

Motion unanimously carried.

Mr. Clark: I move that the outgoing secretary turn over to the incoming secretary all letters and telegrams of regret, etc., and that the secretary acknowledge them, although they need not necessarily be published in the proceedings. These letters and telegrams show at least that these members take an interest in the society, and that should be recognized.

The President: That will be done as suggested.

Mr. Bower: There are three more papers which have been presented, viz.,

"Sturgeon Hatching in the Lake Champlain Basin," by Mr. Livingston Stone, of Cape Vincent, New York.

"The New Code of Fish Protective Laws of Pennsylvania," by Bushrod Washington James, of Philadelphia, Penn.

"Brook Trout Notes," by W. T. Thompson, of Nashua, N. H.

We probably have not time to read and discuss them, and I therefore move that they be printed in the transactions.

Motion unanimously carried and so ordered.

Moved that the secretary be authorized to edit and print 500 copies of the proceedings.

Motion unanimously carried.

The Secretary: I move that any member who furnishes a paper here be given five extra copies of the transactions free, if he wants them, by paying for the carriage.

Motion unanimously carried.

The President: I desire to remind you that at 4:30 you are to take a carriage ride around the city, and if there is no further business, a motion to adjourn will be in order.

The society then adjourned sine die.

Deceased Member since last meeting,

Collins W. Walton.

PART II.

PAPERS AND DISCUSSIONS

THE POWER OF THE STATE TO REGULATE FISHERIES, AND THE TAKING OF FISH.

BY EDWIN E. BRYANT.

The purpose of this paper is to give some general principles as laid down by our Courts, as to the power of the State to control and regulate the taking of fish in all waters, save private and artificial ponds where the fish are rightfully confined from passing into waters not owned by the proprietor. No attempt is made to give the legislation of the various states, which is variant, changeful to fickleness, and oscillating from harshness and unreason to unreasonable laxity; and everywhere but indifferently enforced. The scope of this paper is confined rather to those general principles underlying all legislation on the subject of regulation and preservation of fish and game. It is rather a collation of the doctrines of the Courts than an expression of personal opinion. A few suggestions as to the proper framing of protective laws are added; and these, so far as they are the subject of criticism, the writer and not the Courts, must be answerable for.

I. *The ownership of Fish and Game.*—The fundamental principle on which legislation of this kind rests is that the ownership of fish and game in the wild state is in the State, in trust for all the citizens. English doctrine is that the ownership is in the King, as the representative of the sovereignty, in trust for his subjects. And it was centuries ago the settled policy of the common law that the hunting and killing of game or the catching of fish in public waters might be regulated under the police power of the government.

The property of the King passed to his grantees under the various grants made by royal charter, and vested as an incident of sovereignty in the states upon their being absolved from allegiance to the British Crown. Martin v. Waddell, 10 Pet. 367; Russell v. Jersey Co., 56 U. S., 15 How. 426.

The power in the government to enact laws in regard to fish, to which this paper is limited, has been repeatedly affirmed by the Courts. It was held by the Supreme Court of Massachusetts in 1809, that the legislature might regulate the taking of fish within the state and oblige all persons to conform to the regulations by inflicting penalties for the violation of them. Burnham v. Webster, 5 Mass. 266; Nickerson v. Brackett, 10 id. 212. This power may be exercised for the protection of the fish, to prevent extermination of the species, and for the maintaining of equality in respect to the right to fish, and the state may regulate fisheries by reasonable regulations. Holyoke Water Power Co. v. Lyman, 82 U. S. 500; Fish Commissioners v. Holyoke Water Power Co., 104 Mass. 446.

The cases declaring or recognizing this right are very numerous:

Barber v. Cummings, 20 Johns. 90;
Gentile v. State, 29 Ind. 409;
State v. Norton, 45 Vt. 258;
People v. Collison, 85 Mich. 105;
Magner v. People, 97 Ill. 320.

II. *To What Waters the Right of Control Extends.*—The right of control and regulation of the fisheries extends:

1. To the inland rivers and streams, whether navigable or not, but it does not extend to private or artificial lakes or ponds, artificially stocked and having no connection by channel with other lakes or streams of a public character. The property of such fish is in the private owner.

2. To all lakes or ponds, except such as are subject to absolute private ownership. In the western states, the meandered lakes are not the subject of private ownership but the fee is in the state, of the soil below low water mark.

3. To private waters as well as to navigable streams; that is, to streams where the waters flow in non-navigable streams through the lands of more than one owner.

4. And each state owns the bed of the tide waters within the state, subject to the paramount right of navigation (McCready v. Virginia, 94 U. S. 391.), in trust for the enjoyment of the public right of fishery, which the state may control. Manchester v. Massachusetts, 139 U. S. 240. This right extends on the

shores of the ocean, a marine league from the shore. In these waters the state may regulate fisheries.

5. The ownership of the soil, under low water mark, in the lakes of the states, and the public right of fishing in them is disencumbered of any question of riparian rights. In Wisconsin, two decisions have recently been made which are of interest in this connection. In the case of the Nepee-Nauk Club v. Wilson, 96 Wis. 291, a small stream of water had expanded out into a pond from 35 to 65 rods in width and 3 miles long. It was known as Mud Lake, and there was little or no current during the greater portion of the year. The rushes and wild rice grew in the summer time luxurantly, and the surface was interspersed with mud and bog, leaving open some small spaces of clear water. In ordinary stages it was navigable only for canoes and small boats. It had been meandered as a lake in the original surveys. The Club acquired the riparian rights and sought to hold the exclusive right of fishing and duck shooting on the waters. The Court held against them, declaring that it was not a stream, but a "lake," and that their right to the soil terminated at low water mark. The public could fish and fowl there in open season, to the disgust of the members of the Club.

The other case, is that of the Mendota Club v. Anderson, 101 Wis. 479. The facts were that a dam had been put in at the outlet of Lake Mendota in 1850. This caused the waters to rise some feet and flowed lands not flowed or but partially flowed before the dam was built. Since the dam was built the lands claimed by the Club as its own private preserve were constantly flowed and navigable to small boats, sail boats, etc., and outside of the original meander line. In 1874, the title under which the Club claimed was obtained by a tax deed for the fractional lots to that portion of the shore. In as much, as if the dam had never been raised the riparian owners could have claimed much land that was covered by the flowage caused by the dam, the members thought their title to that part of the lake was exclusive, but the Court shattered their dreams of exclusive occupation of fine fishing and ducking grounds by holding the lake to be public waters, as far as it extended by the raise of the dam at least as against the title derived twenty-four years after the dam was built.

III. *The Legislature may prohibit persons from catching fish on their own land in the close season.*—The private right of fishery on one's own land, where the stream runs through one's land or therefrom onto the lands of others, is subordinate to the public welfare, and one may be forbidden by law to catch fish on his own land during the close season. Hooker v. Cummings, 20 Johns. (N. Y.) 90; Com. v. Chapin, 5 Pick. 199; Vinton v. Welsh, 9 Pick. 87. The right of the riparian proprietor is subject to such regulations as the legislature may make for the common benefit. Com. v. Bender, 7 Pa. Co. Ct. 624; Peters v. State, 96 Tenn. 682; People v. Doxtater, 75 Hunn. 472; People v. Collison, 85 Mich. 105; People v. Hanaford, 18 Me. 106; People v. Bridges, 142 Ill. 30; Com. v. Look, 108 Mass. 452.

IV. *The Legislature may prevent the Obstruction of the Free Passage of Fish.*—This is a lawful exercise of police power. Com. v. Essex Co., 13 Gray 274; Holyoke Water Power Co. v. Lyman, 15 Wall. 500. And after a company had been granted a charter to build a dam, a subsequent statute requiring it to build a fishway is not unconstitutional. id.

Every owner of a dam or other obstruction in a stream holds it on condition that a sufficient passageway be allowed for fish to pass up and down the stream. Stoughton v. Baker, 4 Mass. 524; Cottrill v. Myrick, 12 Me. 229; Parker v. People, 11 Ill. 581; State v. Slunke, 21 Pac. 675; State v. Roberts, 59 N. H. 256.

V. *The Legislature may Prohibit the Sale of Fish and Game or the Shipment of the same from the State.*—The state legislature, in order to prevent the too rapid destruction of fish and game, have in some of the states, enacted laws, to prohibit the shipment of fish or game from the state. These provisions have been the subject of important adjudication. In Magner v. People, 97 Ill., 320, it was held that, as the property of fish and game in the wild state, is in the state, and within the state control, the state legislature may prescribe the terms and conditions on which the ownership may be transferred upon capture, to the individual. And the state may as a condition provide that fish or game so captured shall not be shipped out of the state. The State of Connecticut, in 1888, passed a law that no person should kill woodcock, quail or ruffled grouse for the purpose of convey-ing the same beyond the state, or should transport or have in possession with intent to procure such transportation, any of such birds killed within the state. This statute was challenged as unconstitutional. The Supreme Court of Connecticut sustained the law, and it went on writ of error to the Supreme Court of the United States. That court divided on the question, but the majority held with the state court, so that the principle may be considered settled that the state can forbid the killing of game or fish except for domestic use. The doctrine was stoutly combated in the dissenting opinion. Mr. Justice Field denied the soundness of the rule that the state was owner to the extent that it could qualify the ownership of one who had lawfully killed or taken the fish or game. He contended that after the capture the property of the captor was absolute, and that he could dispose of the property as he pleased, and that it being an article of commerce, the state could not restrict the sale of it to be sent out of the state. In this view Justice Harlan concurred. Brewer and Peckham did not sit in the case.

But here, it will be seen that judicial opinion is much divided. A state law of Kansas made it unlawful for any person to transport out of the state certain animals and birds embraced in the term "game." The defendant, an agent of the Adams Express Company, was prosecuted and fined under the act. He admitted the act, but contended that such acts constituted no offense as the act was unconstitutional and void. The Supreme Court of Kansas held the act void as interfering with interstate commerce. But here the court overlooked the crucial point,—that is, that the state can part with its ownership of game birds in the wild state on such terms and qualifications, as it deems wise, and can as a condition of the privilege forbid their shipment, after caption, out of the state.

The Supreme Court of Massachusetts has gone farther than other states, and farther than seems necessary. It holds as constitutional, a law forbidding the sale, during the close season, of fish artifiicially propagated in private ponds. Com. v. Gilbert, 100 Mass. 157.

The state laws forbidding the having in possession during the close season, or the serving as food at hotels and restaurants, are upheld. State v. Beal, 75 Me. 289.

Some difficulty has arisen here. The statutes are variant. Some include fish and game lawfully taken in the close season, and game or fish sent into the state from beyond its borders. Others, except these; and in some cases, where the statutes were silent on the point, the courts have held the state laws inapplicable to game lawfully taken and to that brought into the state. The burden of proof being on the state to prove that the game was of domestic origin, great difficulty in procuring conviction was found.

VI. *The Power of Wardens to seize and destroy Nets in illegal use.*—The legislature may by law declare all seines, nets, set-lines, traps, spring guns, etc., set for the unlawful killing of fish or game, public nuisances, and may authorize the officers to destroy them when found in such unlawful use. Weller v. Snoover, 42 N. J. Law, 341; State v. Lewis, i34 Ind. 133; Lawton v. Steels, 119 N. Y. 226-234. This kind of statute does not interfere with a constitutional right. It is analogous to those that declare it criminal to have in possession counterfeit money or dies or tools for making the same, or the laws which authorize the seizure of liquors kept for illegal sale. Mugler v. Kansas, 123 U. S. 623; Kidd v. Pearson, 128 U. S. 1.

The case of Lawton v. Steels, 119 N. Y. 126 is a leading and important one on this point. It was held by the court of Appeals of New York that the state might declare illegally set nets, when found in unlawful use, public nuisances, and that officers might destroy them when so found and seized. The case then was taken to the Supreme Court of the United States, the contention being that the state law deprived the owner of his property without due process of law. That tribunal affirmed the decision of the New York Court, and Mr. Justice Brown in his opinion discusses at some length the cases where there may be a summary destruction and those in which there should be an adjudication before there could be a destruction of the property. The instances where there should be a condemnation are those where the property is of very considerable value, such as a vessel, teams and supplies in lumbering horses, etc. There are several cases in the state courts, where a technical view has been taken and such laws declared unconstitutional. For example; In Ieck v. Anderson, 57 Cal. 251, the summary confiscation of the boats, nets and tackle was held a depriving of property without due process of law. In Jensen v. State, 7 Ohio Com. Pleas 18, it was lately held that the statute of Ohio, giving the power to any person to take and summarily destroy nets, etc., illegally set and making it the duty of wardens, their deputies, sheriffs and constables to destroy such apparatus wherever found, whenever such officer should *think* it was illegally set in violation of law, was a depriving of property without due process of law.

It is manifest that such laws will always be debatable ground. The power is a harsh one, but that it can be exercised within certain limits seems clear.

Some statutes have gone further and authorized the seizure and destruction or confiscation of property that is in possession with intent to illegally use, or that has been illegally used, but is not in such use when seized. Such laws are of doubtful constitutionality and are unnecessary. Bittenhaus v. Johnson, 92 Wis. 586; 32 L. R. A. 380.

But the power of the state to declare as public nuisances, articles of property while in illegal use, is asserted in numerous cases.

Cox v. Schultz, 47 Barb. 65;
Re Jacobs, 99 N. Y. 98;
McLaughlin v. State, 45 Ind. 336;
Miller v. New York, 109 U. S. 385;
Wood on Nuisances, 1;
Williams v. Blackwell, 2 Hurlst, etc. 33;
Smith v. Com. 6 B. Monroe, 21;
State v. Bailey, 21 N. H. 343;
Meyer v. State, 42 N. J. L. 145;

And where one voluntarily places his property in a situation where the law says it may be summarily destroyed, he cannot recover either in value or kind. Cooley's Const. Lim. Ch. 16; Com. v. Kelley, 163 Mass. 169; Campbell v. Evans, 65 N. Y. 356; Cook v. Evans, 46 N. Y. 439.

VII. *The Power of Wardens and other Officials to enter upon Private Lands and there seize and destroy Fish Baskets, Traps, etc., set for illegal Fishing, even by the Proprietor of the Soil,* is well established.

Weller v. Snoover, 42 N. J. L. 341.

And the officers are not trespassers for so doing. id.

VIII. *The Right of the Riparian Owner to Fish on Waters covering his own Soil.*—We have one vexed question in connection with the stocking of streams, by state instrumentalities. At the Common Law as laid down in many American cases the riparian owner (whose right in fee to the soil extends to the thread of the stream, where the stream is his boundary, and to the whole bed of the stream when he owns on both sides), the right of fishery is in him exclusively, and no stranger can fish in the stream against his will without being a trespasser.

There are not wanting numerous authorities holding this view, even as respects navigable streams, in those states which hold that the riparian owner owns the soil under the water subject to the public right of navigation. It was held in Wisconsin that the owner of both banks of a stream owns the bed, and the owner of one bank owns to the center or thread of the stream, whether the stream is meandered or unmeandered.

Jones v. Pettibone, 2 Wis. 208, 319;
Mariner v. Schuette, 13 id. 692;
Walker v. Shepardson, 4 id. 486;
Arnold v. Elmore, 16 id. 509;
Norcross v. Griffiths, 65 id. 599;
Olsen v. Merrill, 42 id. 203;
Janesville v. Carpenter, 77 id. 288;
Barney v. Keokuk, 94 U. S. 324.

The right of fishing and fowling is in the owner of the soil under the water. Ne-pee-nauk Club v. Wilson, 96 Wis. 290.

This doctrine that the owner of the bank owns the soil under the navigable stream does not obtain in many of the states. In others including Wisconsin it has gotten unluckily a foot hold, and is an embarrassment to the stocking of fish for the public benefit.

In Wisconsin, the rule of riparian ownership of the soil carries with it the exclusive right of fishing in the waters over such soil has been overturned by the late case of Willow River Club v. Wade, 100 Wis. 86. The club leased the lands for a considerable distance on both banks of the Willow River, an unmeandered tributary of the Mississippi River, which was in times of high water capable of floating logs and small row boats, though at other times row boats can not be taken up the stream without dragging or pushing them over shallow places. Wade, defendant, entered upon this stream from a public highway which it crossed, and thence went by boat up stream and caught fish by hook and line in a pond the plaintiff, the club, had created by erecting a dam on the stream, for the purpose of widening the stream and making a fish pond of it. The court after a very learned argument, held the stream a public navigable stream, and that the public had a right of fishery in it while passing up and down it, and keeping within the limits of the stream, and not going upon the owner's dry land to get to the stream. This happily settles one phase of the question, but others still perplex the subject of the stocking of the lesser streams.

IX. *The Legislature may prevent the pollution of streams, so as to destroy fish therein and may declare the pollution a public nuisance; and such pollution may be enjoined.*

People v. Truckee Lumber Co., 116 Cal. 397;

State v. Kroenert, 16 Wash. 644;

Blydenburgh v. Miles, 39 Conn. 484. Substantially the same rule has been applied in Wisconsin.

SUGGESTIONS AS TO PROTECTIVE LEGISLATION.

In view of the constitutional and other difficulties in framing adequate protective legislation, I venture to offer the following suggestions to those preparing legislation on the subject of protecting fish and game, confining the suggestions only to legal points:

1. The penalties should be imposed as *forfeitures* and not as *fines*. The prosecution should be in the form of a civil action to recover a forfeiture and not for misdemeanor, in criminal form. The reason for this suggestion is that in most of the states, I think in all, the prosecution thus secures the right of appeal, when the justice or lower court, overawed by local sentiment, or sympathizing with the offenders, decides against the state. All wardens know the difficulties attending prosecution in the petty courts. There can be commitment to jail till forfeiture is paid, the same as in case of fines, and in the case of agents of trans-

portation companies no arrest need be made, or it may be made at the institution of the suit. The technicalities of criminal procedure can, to a large extent, be avoided by the mode of prosecution here suggested.

2. The statutes asserting the right of the state in wild game and fish to regulate caption, should be clear in declaring the terms on which they may be taken in open season, should specifically declare the conditions on which the state parts with its property. The right to ship out of the state should be qualified, or altogether restricted in clear terms.

3. A limited period of time after the termination of the open season should be fixed in which fish and game lawfully taken may be used or disposed of.

4. The plan of requiring license to hunt or fish to be taken out, by both residents and non-residents, is a good one. The small fee required should be used as a fund to defray expenses of protection.

5. Where fish or game are in possession in the close season, the burden of proof should be thrown on the possessor to show that they were caught in lawful time, or beyond the state and that they were lawfully shipped into the state from beyond its borders.

6. The laws should not apply to private hatcheries or waters isolated from others and owned and artificially stocked by private individuals. The private propagation of food fish should be encouraged rather than crippled. But care should be taken that this right be not made the cloak for illegal fishing.

7. The laws declaring nets, seines, etc., public nuisances and authorizing their summary destruction, should apply only to such as are actually taken while unlawfully set or in use, and, I think, it would be wiser, where they are of considerable value, to require a judicial condemnation before they are destroyed or confiscated. Where the illegally used articles are boats, guns, vessels, or long stretches of nets, it would be well to have them adjudged forfeited by a court of competent jurisdiction, under simple and speedy proceedings which give the offender his day in court, before they are adjudged to be destroyed or sold. These proceedings should afford right of trial by jury at some stage,

and better on appeal to the circuit court than in the petty courts where original jurisdiction may be vested.

8. Where the state expends large sums in stocking streams the right of the public to fish in them should, as far as possible, be secured. The right to share in the benefit of state stocking should not be monopolized by riparian owners. This subject is a delicate one to handle, especially where the old rule obtains that the riparian owner has the exclusive right of taking fish on his own soil. It will be held generally that he cannot be divested of this right by arbitrary legislation. From those who will not accord to the public this right, as to streams not wholly within their own soil, stocking should be withheld, as far as practicable. In Wisconsin, the law once provided that the applicants for stocking must dedicate their waters stocked by the state, to free fishing; but this law was found impracticable of execution and was modified. Here is need of careful legislation.

9. The state laws regulating the free passage of fish are usually utterly disregarded, or are dead letters because of their inadequacy. They need a thorough overhauling and more vigorous enforcement. The right of the public and of riparian owners to have passage ways for fish up and down the stream is a common law right and a valuable one. Yet, no right has been more systematically and flagrantly disregarded. This right extends to navigable as well as non-navigable streams. Remley v. Meeks, 51 L. R. A. 414.

The dam owners should be required to put in adequate fishways; and the game wardens charged with the duty of keeping them to the obedience of the law.

10. All statutes providing forfeiture, ought to prescribe and declare sufficient suitable forms for the guidance of wardens and officers in making complaints and magistrates in issuing warrants, rendered judgment and issuing other process. This avoids likelihood of mistakes that vitiate the proceedings.

DISCUSSION OF GENERAL BRYANT'S PAPER.

Mr. John W. Titcomb, St. Johnsbury, Vt.: It is a splendid paper. Every one who has to do with the administration of the laws as well as the work of propagation of fish, will appreciate the importance and value of having the different laws on the subject so clearly explained; and if it were not for the short time at our disposal, I should like to talk of some facts with reference to the stocking of streams with fish, and in regard to trespass laws. We think we have solved the problem in Vermont.

General Bryant: I am anxious to hear Brother Titcomb's explanation of how they have dealt with this question in Vermont.

Mr. Titcomb: With reference to the trespass law and the posting of waters, we claim, as your paper states, that all wild game is the property of the state; but take a stream that flows down the mountains for miles, through the valleys, and through several farms, each farmer claims that it is unlawful for any one to trespass on his property. In other words, if you go fishing on his land, or cross his land and fish along the banks of a stream flowing through his land, he can get actual damages for trespass, that is, one cent and costs, and of course he cannot ever keep fishermen off.

Now the state law provided a great many years ago that where a man posted the stream with a poster of a certain size as prescribed by the law, prohibiting fishing and hunting thereon, he could get $10.00 in a civil suit in addition to the actual trespass damages. That law was held to be constitutional. The first embarrassment we met with in connection with that law was the fact that the fish from our state hatchery were going into these waters that were privately posted. We got the legislature to pass a law prohibiting the commissioners from stocking any stream which was privately posted. The result was that at the next session of the legislature the farmers who had streams came in there and said, we don't care a d—n for your hatchery; we don't get any fish; we want the fish in our streams and want to control them. The other faction said, the hatchery don't do us any good, the streams are all posted in our section; and the fight was so hot that the appropriation was held up and there was almost a deadlock on that question. I asked one of the members who was opposing our hatchery appropriation to withdraw a sweeping opposition measure and accept a compromise, which was done. Under the compromise act if a man wishes to have the privilege of obtaining $10.00 in addition to actual damages for fishing on his privately posted waters, he must first stock those waters by purchasing fish that are artificially reared. He cannot go to public waters to stock them, but must stock his stream at his own private expense from artificially reared fish, and keep it stocked. If we have a stream five miles long and one or two farmers post a mile or so of it, under the old law we could not stock the other part of it; but now the farmers buy their fish of a commercial hatchery and stock the portion they want to, the state stocks the rest of it, and that is open to the public; and the understanding is that if the state stocks any of these streams they are then open to the public. We have in connection with our application blanks question blanks so that we can find out whether the land owners agree to accept these fish from the state and will permit the public to have access to these streams after the fish from the state hatcheries are put in there; and the plan is operating very well. A good many who privately posted formerly have given it up and let the public on, and we stock their waters every year. A good many others are buying fish from the commercial hatcheries.

General Bryant: Then the legal effect of non-posting is an acquiescence in the public right to fish?

Mr. Titcomb: Yes, we do not claim that we can force the property open.

General Bryant: But you put the property owner in an attitude where he must waive his rights?

Mr. Titcomb: Yes; the legislature can say whether he shall have that $10.00 additional damages.

Mr. Seymour Bower, Detroit, Mich.: I want to say a word in regard to one of the recommendations made by General Bryant, and that is in reference to the sale of brook trout by private breeders. It seems to me in a good many of the states we are altogether too severe in that respect. In my state a man cannot buy a brook trout from a private breeder and serve it to the public, in a hotel, without being liable to prosecution. Now in the state of Michigan I have no doubt that within five years, if private breeders could be allowed to put their trout upon the market, we would have twenty-five trout hatcheries at the least calculation, and would be getting fifty thousand dollars to one hundred thousand dollars of good Chicago and St. Louis money every year that we might just as well have as not; and it seems to me that there should be some practical way to surround the sale of these fish with such provisions as will prevent the sale of wild trout. They do these things, I think, better in the state of Massachusetts than we do in the west. In that state, within a radius of fifty miles from Plymouth, are to be found perhaps twenty-five private trout hatcheries, from some of which five to ten tons of brook trout are marketed annually. They are allowed to sell their fish during the open season in which trout may be caught, and in addition they have a special law that allows them to sell in February and March, and as they have five months of open season, that gives them seven months in the year in which to market their fish. The denial of this privilege or right in Michigan (and I think it is the same in some other states) drives out what might become a considerable enterprise. I see no good reason why the production and sale of trout as a private or individual enterprise should not be encouraged rather than suppressed, no good reason why anyone should not be allowed to sell his own property, and I would like an expression of opinion from others on this subject.

Mr. Clark: It was my intention to say not a word in regard to this paper, but Mr. Bower has brought up this point and I wish to add my mite. That question has been before me ever since the law was passed in the state of Michigan. Time and time again, have people said to me that they would go into the business of raising trout for market, but they could not sell them. I do not believe—and I want to put myself right on record here as saying so—that any such law in the state of Michigan will stand. If I were a private trout breeder today, I would breed my trout, raise and sell them. I do not see how you can stop a man from selling his fish that he has raised in his own private waters any more than you can stop him from selling beef. But the law should be fixed so as to encourage this industry, and one result would be that we as public breeders of fish both national and state would have a better opportunity to buy eggs from different parts of the country, just as we do today from the breeders in the east. In Wisconsin, Michigan and all of these trout states, if that industry were encouraged by the law, in the first place we would have, as Mr. Bower says, a great many of these private trout breeders who would raise trout for market, and by having the surplus trout we would have that many more eggs, because the eggs would simply go to waste if they did not save them, and thus eggs would be much cheaper.

James Nevin, Madison, Wis.: They are permitted to do that in Wisconsin at any time.

Mr. Titcomb: As to the constitutionality of that law there seems to be no question. Gilbert, of Massachusetts, caught trout out of his artificial rearing ponds, served them on his own table, complained against himself, carried the test case to the Supreme Court and was beaten. However the matter was finally compromised and I do not think that in Massachusetts or in Vermont (Mr. Root can tell you about Rhode Island) we experience any trouble from allowing artificially reared trout to be sold in certain months during the close season. In Vermont we have just passed a law looking to the encouragement of farmers putting in artificial ponds to hatch their own fish, to raise them and eat them any time in the year on their own premises.

The President: But they cannot sell them.

Mr. Titcomb: They are not supposed to sell them except in certain months, but the months that they are allowed to sell them are when there is a demand for them. I think if the matter is properly presented to the Michigan legislature there will be no trouble in getting a proper law there.

Mr. Root: We have experienced no difficulty at all in the matter in Rhode Island. We saw some years ago that such a law as exists in Michigan would oppress some of our artificial breeders, and I went before the legislature myself and had a simple law to this effect prepared and passed without any objection at all. The fish raiser goes to the secretary of state and registers himself, pays a small fee of a dollar and certifies that he will brand every package of fish that he sends out with the name of his concern; that has to be put upon the box; and that allows him to sell at any season of the year. There has been no complaint made of the law, and if anybody wants a package of fish he has merely to mark his package and that is prima facie proof that the vendor has a right to sell them, and these packages can be sold anywhere and at all seasons of the year.

Mr. C. H. Townsend, U. S. F. C., Washington, D. C.: It seems to me that the effects of legislation on the fisheries and on fish culture are so far reaching that the entire time of this meeting might very profitably be taken up with the discussion of this subject. We know that the fisheries have a great many limitations on account of the laws, and there is a great lack of uniformity in the laws. A study of the subject and a report thereon that would lead to uniformity in fish laws would be of the greatest benefit to private fish culture. I have recently had some correspondence from Montana on this subject. There the conditions are different from any of those that have already been mentioned. and I have no doubt that if members from other states were to tell of the conditions prevailing with them, that they would be seen to be still different. In Montana commercial fishing from the streams is forbidden, but it is not forbidden to take fish from the public waters for the stocking of private ponds, and many people in Montana are industriously fishing to stock their private ponds and lakes. These immediately acquire a commercial value, and the sale of fish from such waters goes on, so that any one wanting to sell fish in Montana has only to get fish from the public waters and put them for awhile in their private ponds when they can be regarded as the result of fish culture.

A few years ago the statistical division of the Fish Commission made a canvass of the fisheries of the interior waters, where the commercial fisheries yielded over 50,000,000 pounds of fish. This year the same region was canvassed and we found that since the previous investigations the laws had been changed in many of the states. In Kansas, for instance, you cannot fish except with hook and line. The fish are no scarcer in these states but the fishermen do not get them. Commercial fishing being cut off in many states we found it useless to attempt a canvass of the commercial fisheries of several sections of the west, because of fish laws that prevent the utilizing of many kinds of fishes that could be taken if netting were permitted. Fish laws of the right and proper kind need not break up all fishery industries.

Mr. Geo. F. Peabody, Appleton, Wis.: The work of stocking the waters of Wisconsin by our State Fish Commission has been generously and intelligently done, and not only have the inland waters been stocked and those waters which furnish sport to the angler and the thousands who like to go fishing, but there have been vast quantities of fry hatched and put in the out-lying waters for the benefit of the commercial fishermen.

Lake Winnebago and the Fox River (where I live) are the storm centers of illegal fishing, and the illegal fishermen and the pirates have been encouraged by the protection of the "A. Booth Fish Co." Wagon loads and wagon loads of illegally caught fish have within the last few months been taken en route from Lake Winnebago to Green Bay. They have been bought and shipped knowing that these game fish have been illegally netted in the inland waters of Wisconsin. It seems to me it is time the Fish Commission and Legislators take note of these facts.

Mr. Titcomb's remarks in which he said, "that they did not stock waters that were private in Vermont," is analogous to the idea that the State Fish Commission of Wisconsin should not propagate fish for the benefit of a corporation that assists piratical fishermen to break the law by buying illegally caught fish, knowing that such is the case. The transportation companies respect the law and refuse to ship fish from these waters, and the only way that we shall be able to correct the evil is to make it unprofitable for the illegal fishermen, first, by stringent laws, that make it possible to destroy the utensils, nets, boats, etc. Then to destroy the market, and the thing is done.

It would seem as if some one state might originate a clear rational law that could be adopted by other states that would be effective.

The President: I had this very point in mind when I suggested the subject of building up public sentiment. Before we can pass proper laws we have got to interest the public and create public sentiment in the interest of fish culture.

MAN AS A CONTROLLING FACTOR IN AQUATIC LIFE.

BY DR. J. C. PARKER.

The inexorable logic of human progress for the century, just past, would seem to indicate that "the Power that makes" in the Universe, if intelligent, had made a mistake in the arrangement of things: for instead of bringing man on to this stage of action as the last creative act, he should have been the very first and then left in absolute fee simple with the raw material of this earth at least—on his hands—to fashion as he might. For ever since his advent, he has been "eternally fixing things up" so that he might be more comfortable. He found himself in need of a "Shirt Waist" and other things and as the "Power that makes" had not furnished any, he had to hustle around and rob the wild beasts of their hides to keep his own warm. He wanted Milwaukee bricks and "Marble Halls" and the "Power" had only furnished dauby clay and rocky ledges. So he had to get up and hustle for a habitation. He found that his powers of locomotion were too slow, that in this respect the horse and the camel were his superiors and so he persuaded them to carry him wherever he wanted to go. But he wanted to go as fast as any thing on the face of the earth, and the fastest thing he knew anything about was the birds, so he wanted to fly. Well! he tried that but so far the bird is ahead, but he harnessed a tea kettle to a wagon and by keeping "eternally at it" he has a railroad and palace cars and has come as near flying as possible and keep his feet on the ground. He wanted to cross the river and he goes astride a log, then paddles across. Now he builds steam ships a quarter of a mile long, thus can go around the world in the time it would have taken to go from New Orleans to New York at the beginning of the century. He was afraid of the dark so lighted a pine knot, and that pine knot has grown to be an arc light and turns night into day.

Along every avenue of the inorganic he has been a builder. He is the only animal that has ever existed who has left anything besides his bones to mark his place in nature and if by any convulsion he should be wiped out of existence, and in aeons of ages to come, some creature endowed as he is, should come upon the stage of action, he would still find evidences of his power as a builder.

But in the realm of the Organic! What of him there? A builder? No, only a destroyer! Down through the whole march of the ages, his record has been that of the most terrible beast on the face of the earth. His "Slogan" was ever: Kill! Kill! Kill! and every created thing from his own species to the worm under his foot has been the victim of his rapacity. Those beasts that he could not tame and make subservient to his need, he exterminated. Every beast of the field has learned to fear him. The birds of the air have learned to hasten and prolong their flight beyond his deadly presence. And in the waters that pulsated at his feet! What of him there? What is his record as a controlling factor in the life that swims on the surface or throngs in countless millions beneath? As we listen to the echoes coming up to us from the dawn of recorded history, and throbbing in the ears of the present, comes the eternal cry, Kill! Kill! Kill! From the huge Cetacean whose enormous build and terrible strength rivaled the Leviathan of the innovation of Job, down to the delicate anchovy whose brightness like a silver arrow gleames in the ocean's pelucid waters. In every tumbling brook, in every gliding river, in all the inland lakes shining like gems in their emerald settings; in and among all these he has been "eternally at it" killing and destroying, primarily to satisfy his hunger and his love of gain: and secondly to satisfy that innate love of killing that we euphemistically designate as "Sport." For no matter how much we weave around it the magic of poetry and charm of seductive language, yet all the way from St. Izaak down to that supreme juggler with apt words, Henry Van Dyke the "gentle art" is to kill as many of the fish that inhabit the waters as may satisfy this madness of destruction that riots in the blood of us all.

No one realizes better than myself, that there is another side to this question. There has never been a picture painted in words or on canvass of the beauties of companionship with nature, that has not been painted in my soul a hundred times. I know the sweet joy of the vagabond life of the camp: the uplift that comes from breaking all the conventionalities of daily life: of getting close to the ground, and getting acquainted with its wonderful revelations; of the health renewing strength that comes in the wind that has swept across leagues of water and miles of forests filled with odors sweeter than any perfume: of the worshipful solemnity of the evening camp-fire, when you feel why fire-worship was the first religion: and you sit and listen to the many eerie sounds that come to your city tuned ears out of the solemn woods, wondering what they are and whence they come. And then the preparations for sleep that shall "knit up the raveled sleeve of care" for tomorrow. The splash and splutter of the brands of the camp-fire as you douse it" so that no stray zephyr shall send a vagrant spark into the tinder dry tent, and turn you out in a blaze of terror, and as you sink into the resillient bed of fragrant hemlock, what is the last conscious thought that engages our attention? Isn't it "We're going a-fishing tomorrow!" All the other delights are secondary to this. We take them all in, accept them, as though it was all we came for, and yet we know very well that we wouldn't be there if we weren't pretty sure that we could catch at least a few fish. Of course we are not "fish-hogs," a dozen trout or half as many big black bass would satisfy us, but we would certainly like to kill a few! for that is what we came for after all. No doubt there are those who could get all that has been described and bar the fishing, but I doubt if they ever find their way into societies like this. This brings us face to face with the fact that it is only when we find that these two factors, love of gain, and love of sport have been curtailed through our covetousness or stupidity, that we begin to search for remedies and to ask for the Why! and the How! of things. When commercial fishermen find that the margin of loss and gain, on a trial balance was perilously near the first item, they began to seek some method to rehabilitate former conditions, and when the disciples of Sir Izaak began to find that the streams where they fished when boys would no longer respond to the waving of the "magic wand," when they realized that the "flashing trout" could no longer "rise to the occasion" for they weren't there. And when they asked the old question, "What shall we do to be saved?" And the reply came back, "Sell all thou hast" if thou woulds't go a fishing. Then these too began to ask, Why! and How! To answer these two questioning factions, this and kindred societies have been formed, and through the enthusiasm and wisdom of those who from time to time have thus assembled, some of the problems have been solved, and year by year the How! has been pushed nearer to an answer. To reiterate the story of what has been done, would be to you but an idle tale. You all know what man has taken in that rehabilitation of the waters, from which he has so nearly exterminated their inhabitants. Many mistakes have been made in these efforts, but on the whole, there is I think a perceptible gain, especially in dealing with those waters, over which he can have nearly absolute control, like the inland streams. These he could stock with trout and in them could verify his work. It is the unverified portion of his efforts that is still in abeyance. From the first he has taken so many things for granted that it is no wonder there have been so many failures. If our work is to be recorded as scientific, not empirical, then there should be nothing taken for granted. Science is only an orderly arrangement of facts one fitting into the other like the link of a chain, and to study these from the genesis of life to the revelation of completeness is today the task that is set before the disciples of scientific pisciculture. Our work in the past to which we brought the best that was in us, has been largely empirical, and our reasoning of the a priori order.

When the fact was demonstrated that the ova of certain kinds of fish could be artificially fecundated and hatched, it was then assumed, that if the fry were planted in the waters almost anywhere then the problem of the future supply of the fish was practically settled. So we proceeded to hatch them out by the hundred of millions and dump them into the waters, usually those from which the parent fish had been taken, it being assumed that a large proportion ought to survive to maturity. But somehow there seems to be a hitch either in Nature's plans or our own for after a score of years' trial and a large expenditure of money, we have no assurance that there has been any marked success. In fact we are not *sure* that any one of these hundred of millions has reached maturity. We are not even sure that there has been any particular gain in any one locality. True from time to time our hearts have been gladdened with the reports that the fish have become suddenly much more abundant, and we have no other satisfying reason, why this state of affairs should exist, and we have concluded that it was through our efforts. But have we been equally fair in our statements of our failures? When a few years ago the whitefish began to be caught in commercial quantities in Lake Erie, after a lapse of many years of depletion, we ascribed this sudden development to the efforts of Ohio, Canada and Michigan, in planting them in the lake. A similar phenomenon occurred in Lake St. Clair in the earlier efforts of the Michigan Fish Commissioners, and we were greatly elated thereat, but of those planted along the eastern shore of Lake Michigan I am forced to say there was never any perceptible showing. Depletion went on with each decade, until today we stand face to face with the fact of an almost fishless sea.

Now pessimism is one of the easiest of virtues, and to prophesy after the event is consummated, is a good deal like "betting on a sure thing." But it really does seem as though man as a producing factor in organic life has not been a "howling success." It seems to me that the greatest need is that of verification.

In the case of our minor inland waters, notably those in which the brook trout would live, verification of our efforts was easy: and it was this that gave the supreme impulse to our efforts in pisciculture. If all the other work could have been verified as this has been, all fish culture would today be a scientific and practical success. Perhaps there is no fish that swims in which we are more interested than in the Queen of the Lakes, the White Fish. Fifty years ago, it was one of the most common, as it is the most delicious of fishes. We have seen it slowly decimated until today it has passed from a common article of food to a semi luxury. And if the same rate of depletion continues for another half century, it will be one of the most costly of luxuries. We all know the comparative ease with which the ova of this fish can be collected, and the large percentage that can be hatched. And if we could in any way verify the progress, after planting, as we can the brook trout, "the two blade of grass man" would not be in the "benefactor business" with us for a day longer.

To point out blunders and grumble at existing conditions, without suggesting a remedy, is hardly the province of the reasonable man, and while I have only a tentative plan, certainly not a scientific one. Still it is comprehensive enough to possibly determine the value of planting the whitefish in a large body of water. Lake Ontario was once bountifully supplied with this fish. Today—if my information is correct—it has but very few. Now if all who have an interest in the successful propagation of this fish could pool their interest, and first make an exhaustive examination of this lake to ascertain the exact conditions now existing, as to its aquatic life. Then all the states interested together with Canada and the general government hatch as many millions of whitefish as possible, for say three years, planting them all in Lake Ontario. Then if possible prohibit all commercial fishing for five years it seems to me that it would settle the question for this lake at least, and indirectly for all the others, and possibly demonstrate whether man could be a controlling factor in the larger schemes of constructive aquatic life.

There is another phase of aquatic life to which but little attention, so far as I am aware—has been paid, and that is the plant life of all the waters, of the sea, no less than that of our lakes and streams. As on the land, all animal life is dependent on the vegetation, so in the waters, there could be no organized aquatic life without the primary existence of aquatic plants. In this field, man has indeed been a controlling factor, and may find, possibly, that in the future his best constructive work may be in the study of the growth and conservation of the plant life of the waters. Many times have I known the aquatic life in our inland lakes nearly obliterated by the deepening of the outlet of a lake, in order to reclaim some bordering marsh. If when you are on a lake or stream, you will pull up any of the water plants, during their active summer's growth, you will find them covered with larval or crustacean life. On this small fish feed, and ten large ones on the smaller. And thus the balance of life is complete. Interrupt this in any manner and you have destroyed the delicate poise of the balance. By lowering the water line, the plants will wither and dry up, and with them the life that depended upon them for their sustenance and growth. Then the swarms of minnows deprived of their friendly shelter and food, either starve or become an easy prey to their predacious neighbors, who after having eaten the "fatted calf" cannot find even the "husks to fill up on" and so succumb to the inevitable. I have known lakes in which there was fine bass fishing to become completely depopulated in three years by a foot or two's lowering of the original water line.

To my mind, it is not at all impossible that some disturbing or destructive influence of the flora of our great lakes has more to do with the depletion of its whitefish than the greed of fishermen. I remember very distinctly the surprise that I experienced when I first discovered the food of the whitefish. It was soon after my appointment on the board of the state fish commissioners. I could find no one among authors or practical fishermen who could give me any information as to what they ate. So I made a trip to Grand Haven, at that time having a large interest in the catching of fish. One of the fishermen turned over to me possibly a barrel of intestines, and I started out with a sharp knife, a stout stomach and lots of ignorance to find out what whitefish lived on. I worked diligently for an hour cutting open stomach after stomach but without any result in finding what I was looking for. In nearly every one I found more or less sand mixed with the mucus of the stomach. I finally came to the conclusion that as the fish had been caught in gill nets their detention there had emptied the stomach of all food. Just as I was about to give up for that time I thought I would see how the inside of the stomach looked under a magnifying glass I had in my jacket. Incidentally I looked at some of the sand, when to my intense amazement I discovered that what I had regarded as sand was the shells of a minute bivalve but little larger than a grain of sand and so translucent as to shine as a grain of sand. Of course this was a new world and I commenced all over again, and left with a very thorough knowledge of what those white fish had been feeding on, for there were the shells in all stages of digestion from those recently taken in, to the shell from which the animal had been removed by the digestive process. Still what I found seemed so insignificant to the size of the fish that I thought there might be some mistake so I concluded to remain over night and verify my observation by the next day's catch. I did so with the same results. Then I thought it might be a local matter, and so a few months after I found my way to Mackinac where I made examinations finding only the same evidence of food in fish caught there. Later in the stomach of a ten pound white fish caught on the south shore of the peninsular, north of the Beaver Islands, I found some shells of the genus Melania and Paludina, shells half an inch in length and one-fourth inch in diameter, but shallow water shells, the habitat of which is well known, but I never was able to find the smaller shells only in the stomachs of the whitefish. I am not aware that they have ever been found in their native habitat, or what the vegetation is on which they feed. Of course it may be begging the question to assume that they are vegetarians but the natural sequence of life, so far as we can demonstrate it would lead us to infer that such was the case and if it is, the fate of this fish is to be determined by the growth and continuation of this plant wherever and whatever it is.

I think that man as a builder in organic life especially in aquatic life will work along these lines. What is true of our "unsalted seas" is true of the salt ones. And when in the future the problem of life in the ocean shall be studied from this point of view, some of the puzzling phenomena of ocean life may be solved. The immense schools of migratory fish like the Mackerel, the shad and alewife. On what do they feed? As they are doubtlessly carnivorous and as we must "hark back" to the vegetable world as the genesis from which all organic life proceeds. So in the future the province of man as a factor in aquatic life may possibly be in sowing the fields of the ocean as he today sows the fields of the land.

DISCUSSION OF DR. PARKER'S PAPER.

Mr. Titcomb: I was very much interested in the doctor's remarks and I have often thought that it was unfortunate that we could not show results and prove that they were the results of artificial propagation. He has stated that it is possible with the trout and has been demonstrated. The subject of the growth of fishes under natural conditions is interesting. The fish culturist is so frequently asked for information as to the growth of fishes after being planted that I give the following statistics:

In the spring of 1897 lake trout fry were planted in Big Averill Pond in the town of Averill, Vermont. Each successive spring lake trout fry have been planted in these waters. When the first plant was made the lake contained a few brook trout, a few golden trout (aureolus) and many shiners, dace and suckers, but no lake trout. In June, 1901, I caught with rod and surface troll four lake trout weighing three and one-half pounds, two and three quarters pounds and one and a half pounds respectively, and one fish ten inches long which was returned to the lake alive and not weighed. I was informed by the landlord of a sportsman's resort nearby that the lake trout caught by other fishermen did not vary an ounce from the weights above given. In other words, that the fish representing the various ages from one year to four were quite uniform in weight. The standard weight for a four year old lake trout is therefore three and a half pounds, for the three year old two and three quarter pounds, two year old one and a half pounds, one year old about three-quarters of a pound. Of course the growth may be greater or less in other waters, but the above is an accurate basis for data. I may properly add that my landlord informant considered that his property had doubled in value in the short space of time that this lake had demonstrated results from stocking with artificially hatched fish.

In the fall of 1897, landlocked salmon, fingerlings, were first introduced in Caspian Lake, Greensboro, Vermont, and plants have been made annually since that time. Previous to 1897 the lake was well stocked with smelts. In May, 1901, one landlocked salmon was taken with rod and line, weighing eight and a half pounds, one weighing seven pounds fourteen ounces, and many others weighing from two to five pounds. The lake contained no salmon previous to 1897. The lake is about two and a half miles long by one mile wide at the widest place. It contains speckled trout, ranging from a small fish to five pounds in weight, and lake trout averaging about five pounds in weight, but frequently caught weighing from nine to fourteen pounds. The lake trout were first introduced in 1891.

It is safe to say that a daily average of 200 pounds of trout and salmon were caught from this lake on week days through the month of May, 1901, the results of artificial propagation. In many places we cannot prove that the fish caught were artificially hatched, but the above examples furnish very definite data.

Mr. Clark: I was very much interested in the doctor's paper, but still that paper as it will go to the press affords rather a discouraging outlook for artificial propagation, especially of whitefish. One would infer from the doctor's paper that no results really have been shown with the whitefish. If in order, I want to make a little argument on that point.

It is true that the different states bordering on the Great Lakes, as well as the United States Fish Commission, have planted billions of whitefish in various waters. One-half of those whitefish, I venture to say, have gone into Lake Erie waters. It is well known that the whitefish are on the increase in Lake Erie. The doctor referred to Lake Ontario as being depleted. Lake Ontario until very recent years has had practically no whitefish planted in it—now and then a car load, but very few. Of course in the past four or five years probably 20,000,000 to 30,000,000 or so have been deposited each year. Lake Michigan, Lake Huron and Lake Superior will never show an increase, but will on the contrary show a decrease, until hundreds of millions of whitefish are planted in those waters. We must admit of course that the whitefish grow, because that has been demonstrated. We have lakes in the interior of Michigan today where there never was a whitefish until planted, and we know they are there now. I have caught them thicker with a gill net, myself, than in any gill net I ever saw lifted on the Great Lakes. We know positively that the whitefish that we hatch grow. If we plant them in the lakes and find the whitefish increase, the increase must be due to artificial propagation and planting. I contend that Lake Erie and Detroit River are beyond the time of going back and that they are on the increase as the records will show today, and I never expect to see Lake Erie begin to drop down. Of course it has its years when it will be a little better than others. For instance, the records for last year when completed will not compare very favorably with those of the preceding year, 1899, which showed an increase of 100 per cent. over 1898. Last year there were not so many whitefish caught but that was on account of the weather. On Detroit River last year with three seining grounds the catch was 20,000, and a year ago last fall, 32,000.

The President: And all of the same size practically?

Mr. Clark: We did not have a thousand whitefish by the 15th of November, and all of the balance were caught within about three weeks after that. The year before, we had ten thousand up to the 15th, showing conclusively that it was the weather that kept them from coming up. Mr. Downing had about the same experience in the upper end of Lake Erie.

I do not want to let the statement go unchallenged that the whitefish in the Great Lakes are not on the increase, and I mean Lake Erie more particularly, because so many whitefish have been planted there. Now if we will plant in Lake Michigan, Lake Huron, Lake Superior and Lake Ontario, as extensively as we have in Lake Erie, we certainly shall see the whitefish increase greatly.

The food question today has a great deal to do with the subject. I never expect to see the Great Lakes, even with billions upon billions of fish planted each year, back where they were, because, since civilization has stepped in, we have so much deleterious matter running into them destroying not only the spawning beds but the feeding grounds. The problem may become a serious one, unless science can show us some way of increasing the food of the whitefish; but the fact that we can increase the whitefish is undeniable, for we are doing it right along.

Prof. M. C. Marsh, Washington, D. C.: Dr. Parker refers to the difficulty that there would be in getting an agreement over on Lake Ontario between the states and Canada in regard to this matter. Inasmuch as it is often difficult to obtain legislation from a single state, we may well imagine that it might be very difficult to obtain an agreement between several states and Canada. A very important planting investigation almost exactly in the line that Dr. Parker has suggested has been going on in regard to aquatic conditions in Lake Erie, and a similar investigation has been made also in relation to salt water fish.

Mr. Townsend: I do not know whether the members of the Fisheries Society are familiar with the more or less regular statistical canvasses that are made of the fisheries of the different parts of the country. But it takes a good while with the small statistical force of the United States Fish Commission to get over the ground. They canvass the Southern Atlantic and Gulf states in one season, the Middle Atlantic and New England in another, the Great Lakes and Mississippi another, and then the Pacific coast; it takes three or four years to get over the ground.

The last canvass of the fisheries of Lake Erie showed that there were caught 58,000,000 pounds of fish in 1899, 42,000,000 in 1893, 64,000,000 in 1890, 51,000,000 in 1885, and 29,000,000 in 1880. There has been considerable planting of fish and there has been a great development of the commercial fisheries. The figures are correct as far as they go. We are on pretty intimate terms with the fishing firms and every one of them throws open books and records and our figures are copied from these books. The catch is generally larger than the reports show, because we do not see all the fishermen. We do get hold of the fishery firms however. You will see by comparing these different years with the recent catch of 58,000,000 pounds in Lake Erie that that catch is nearly as big as that of the best year, 64,000,000 pounds, and it is away over what it was in 1893.

Let us take the Great Lakes as a whole; in 1889 these lakes yielded 113,000,000 pounds of fish worth $2,500,000, and there were nearly 10,000 fishermen. This yield compares favorably with that of other years.

Here are some fishery facts that I think you will appreciate: There are 19,000 fishermen on the Pacific coast, taking 219,000,000 pounds of fish a year worth $6,000,000. The catch of shad and striped bass in the Pacific coast states by this canvass,—and these figures were collected by trained statistical agents,—was nearly 2,500,000 pounds, but there never was a shad or a striped bass on the Pacific coast until they were carried overland and planted there.

Mr. Clark: I carried the first 600,000 that were taken there myself.

Mr. Townsend: I think that the study of statistics will show the direct and positive benefits of fish culture in all parts of the country.

The President: Nothing shows it better than the culture of brook trout.

Dr. Parker: Verification is just what I contend for. They verify those things by taking the shad and striped bass over there. But what I contend is that they do not get the results from planting whitefish in the Great Lakes in proportion to what has been done with other fish. I say that in all probability we can account for the condition of affairs in Lake Erie by the increased number of fishermen going there for the reason that it is better fishing.

Mr. Clark: But it is better fishing there because there are more fish.

Dr. Parker: We do not know whether that is the result of planting or of natural causes.

Mr. Clark: How will we ever know? Take your brook trout streams in Michigan today that were planted before they were depleted, how do you know that your brook trout lived there?

Dr. Parker: Because you have put the brook trout where there was none and they have grown.

Mr. Clark: No, no, but take the natural streams where there are plenty of trout.

Dr. Parker: There are plenty there today.

Mr. Clark: But according to your argument I might just as reasonably say that your artificial trout that have been planted in those streams do not live.

Dr. Parker: You do not know whether they live or not.

Mr. Clark: No.

Dr. Parker: I am taking this thing up from a scientific point of view, considering the actual facts of the case—that is all —I heartily believe in the commission, and my suggestion as to the planting in Lake Ontario there in that way is simply to prove if you can the value of planting in large numbers, stocking a lake like Ontario. It is only a suggestion.

Mr. Clark: That is just the point I am arguing that the vast quantities of whitefish that have been planted in Detroit River and Lake Erie must make the increase, for we certainly have an increase there.

Dr. Parker: But you assume that this increase is due to the fish you plant there.

Mr. Clark: I dislike to take up the time of the society but this is a very important question and it must be discussed here. The doctor says, "Take Lake Ontario" (which of course is a good example; it is all right), but how will we prove anything better in Lake Ontario than we have already proven in Lake Erie? The only difference between the two lakes is this, that

Lake Ontario is a little more depleted; but the whitefish are not all out of Lake Ontario. Whitefish have been caught in Lake Ontario every single year.

Mr. Townsend: Yes, but the laws of New York so restrict commercial fishing in Lake Ontario that you cannot tell anything about it.

Mr. Clark: If we should plant billions of fish in Lake Ontario could we prove any more clearly than we already have in Lake Erie, that our fish grow there?

Dr. Parker: It seems to me you could, simply from the fact that an exhaustive examination of Lake Ontario should be made first on a really scientific basis, and then stock it in that way, and then if you could prohibit fishing for five years and then found that the fish had increased there, you would certainly have verified in that lake and presumably for all other lakes, the fact of the growth of the fish planted. That is all that I contend for —not that I am inimical to planting fish—not by any means.

The President: The catch on the Detroit River year before last was bigger than for years before and was all of such uniform size that it is almost positive evidence that they were planted fish.

THE INDEX.

BY JOHN E. GUNCKEL.

The American Fisheries Society is likened unto a lake nestled at the foot hills of the Rockies which contain all the songs the mountain brooks and streams have sung. Drop by drop from the snow-clad, unexplored peaks, the water forms overflowing basins, hesitating pools, miniature cascades, and cataracts of unsurpassed grandeur and magnificence; lost for a time in the recesses of heavy forests and then peacefully flowing through overland meadows of wondrous shades and beauty.

It took thirty-one years to gather into this American Fisheries lake the knowledge gained by systematic observation, experiment and reasoning of its members.

The records of the past century reveal that this society, within its life, has made more progress in the details of scientific researches than during all the past centuries. As evidence of this fact read the official reports of the transactions of our society. The progress in the art and sciences made by men whose lives were devoted to the beneficiary work of mankind should receive more than a passing notice and recognition of their discoveries and labors.

It is therefore fitting that we should frequently stop in our active daily work and pay tribute and respect to our absent fellow companions who worked so diligently and earnestly with us for so many years and are now sleeping away the centuries. Men who devoted their lives to the cause of fish culture, the fisheries and marine biology, and "The only reward they asked—a grateful remembrance of their work."

Dr. Theodatus Garlick, Prof. Spencer F. Baird, Prof. G. Brown Goode, Judge Emory D. Potter, Col. Marshall McDonald, Fred Mather, Herschel Whitaker, Henry C. Ford and many others whose names and valuable works you will recall. Around these men circle memories that time cannot efface. These men were leaders in biology and general scientific researches. To them and their associates the American people owe much; more than a memorial tribute of words. They discovered and harvested fields that many of us today are but gleaners. In the life of this society the road was discovered that is leading rapidly to the solution of great problems in nature's marvelous works. Fish can now be artificially hatched with more success than nature gives to the fish in their natural elements. The hatching facilities of every state in the union should be so enlarged and improved that millions of young fish can be planted every year of our most important food fishes. This is helping mankind. Today the life of each inhabitant of God's creative waters is known to the fish culturist and biologist from the fry and fingerling to the self-supporting fish, and all diseases known to fish from the trout down to the palatable cooking of our much abused German carp. In the memory of all of us, who have watched the interests of this society, we recall the papers and discussions giving the results of hard labor and untiring study in detail of the successful hatching and caring for almost every species of our food fishes.

So deeply interested were the workers in details that it made but little difference what subject the member was pleased to introduce the discussion invariably ended in fry and fingerlings arguments. It seems that the beginning of a new century found this fry and fingerling subject amicably settled between the two great contestants, namely—the Michigan Fish Commissioners agreeing with the New York Fish Commission that the future welfare and the progress of the fish, for the benefit of mankind, "depends upon the health of the fry, the condition and surroundings of the fingerlings."

So thorough and complete has been the successful workings of the members of this society that the world is not surprised to learn that they are daily cultivating fields in new and unexplored territory. We are not surprised to learn that the members of the Wisconsin Fish Commission are not only contemplating the hatching of whales at their Bayfield hatchery but they are on record as promising "to hatch a brewery for each member in attendance at this meeting," and we are informed they stand ready to fulfill their promise.

What of the future?

In the index of today we find the members of this society are branching out in other pastures. Some are endowed with talents other than those of solving nature's mysteries. General E. E. Bryant, one of Wisconsin's favorite sons, while under the influence of a Narragansett clam bake, and the ozone of Wood's Hole, surprised the members that he was a natural born orator; deep, inspiring, pathetic, amusing, and that he lost himself in such an overflow of language that the members of the Michigan Fish Commission are still searching the dictionary for fry and fingerling meanings.

Again, the medium through which the public is benefited from the results of the labors of individual members is the record of transactions. It is an honor to this society, a great credit to Secretary Seymour Bower, for the complete and general arrangement of the report for 1900. Would it not be well for this society to go still farther in their annual reports by following New York's most elegant official report of the State Fish Commission? A volume more complete than our present form would be an everlasting honor to our society. In glancing at the many papers and discussions of men like F. N. Clark, C. E. Brewster, H. W. Davis, George F. Peabody, A. N. Cheney, Prof. A. D. Mead, Hon. Eugene G. Blackford, W. DeC. Ravenel, Hon. George M. Bowers, J. W. Titcomb and many others we are not surprised to learn that they are uniform in one belief that great problems of the future increase of our food fishes center in the success of what is now in progress by active members of today who are to read papers and discuss this new movement. No man is better able to tell us what is required of our legislators to guarantee to the people, "Practical Protection and Perpetuation of our Wild Life," than our esteemed Grant M. Morse, Michigan's State Game Warden. He has carefully studied the past and concludes that there is but one way to make this a success. He argues that men and fish are now one, that fish planted in the lakes and streams hatched by members of this society feel as if they were under obligations to their friends—the fish culturists. Therefore, he will suggest that fish should be requested not to feed upon their kind, not to enter a net or trap, or other evil devices of man, and do away with "Uniform General Laws." This idea is sanctioned by one of our oldest and most revered members, Dr. J. C. Parker, for he is satisfied that, "Man is a controlling factor in aquatic life." We have had hints of this coming event from the studied pen of F. N. Clark, who, back in the nineties declared that, "Fry and Fingerlings one day would form a trust which would unite the food fishes of our waters." C. E. Brewster also told us that, "There will come a time, some day, when fish will understand each other." Seymour Bower, who knows every fish by name is recorded as saying that, "Fish in our Michigan waters have been casting Goo Goo eyes at each other to beat the band." Dr. James A. Henshall who is studying the habits and dispositions of our mountain stream fishes said, in the long ago, "In the study of the black bass we are convinced they are leaders and at no distant day will they unite in a powerful combination for self protection." Georgia's famous fish culturists through J. Bayard Lamkin in his paper on, "Feeding of Black Bass Fry" and J. J. Stranahan, late of Ohio, have come to the conclusion that to, "Prevent Cannibalism in rearing black bass," is to teach them in their fingerling years to eat Georgia watermelons and other carp nourishing delicacies. There is a unity in this problem even after death, for S. P. Bartlett, Illinois' carp champion, in his "More About Carp" will tell us that there has been no fish ever discovered in ancient or present times which can be served in more courses and under more different names than our Illinois carp.

These are pleasing problems and incidents arising from past associations with men of this society, living under their influences, and we desire to add to the ties that bind, our word of appreciation, to those who daily toil in the biological fields that, we humble disciples of Isaac Walton love to cast our lines in pleasant places.

Sitting on the banks of this American Fisheries lake are men of my nature and kind, endowed with truthful proclivities.

Men who love to fish in its peaceful waters and get inspiration from the purple shadowing landscape. Men who love to angle, and by their nearness to nature and nature's God could not tell a lie if they saw it.

We are in touch with our scientific workers, although we may not understand all the new ideas advanced in the aquatic life, but we do agree—

"That in every kind of weather
Under cloud or in the sun
Trout and minnow play together
When the American Fisheries meet."

THE BROOK TROUT DISEASE.

BY PROF. M. C. MARSH.

The affection which I have designated "*the* brook trout disease" is one which has caused the United States Fish Commission considerable trouble of recent years. The first occurrence that was particularly studied was at the Northville, Mich., hatchery in the fall of 1898 and following winter. It has also occurred at Manchester, Ia., at the commission's station. These places have had, I think, regular recurrences of the disease each season since the initial attack. It has recently for the first time taken hold of the Loch Levens and it is therefore probably not essentially *the* brook trout disease, though it seemed such at first, for no other species was affected though identically exposed, and it was the only serious obstacle to brook trout culture.

Members of this society are doubtless familiar with the account by Prof. Calkins of a very interesting epidemic among brook trout, published in the report for 1898 of the Fisheries, Game and Forest Commission of New York. This took place on Long Island, and is, like the one under consideration, an infection, i. e. it is caused by living parasitic micro-organisms. They resemble each other in severity and in external lesions, but I do not however believe the parasites are identical in the two cases.

In the earlier literature of fish culture this disease does not appear, none of those described so specifically by Livingston Stone as affecting fry being identical with it. Mather however describes one at Cold Spring Harbor, N. Y., which resembled it and might have been the same. He sent circular letters to various fish culturists, inquiring for similar epidemics and but one reply described a similar and perhaps identical experience. This was at Caledonia, N. Y., in 1883 or 1884.

In this paper I intend to describe the disease only briefly, but to enter at some length into the question of its prevention and to present for your consideration and criticism the reasons which seem to me to justify the plan for putting prevention into practice.

In the experience of the commission the disease affects chiefly yearlings, but also fry. The first symptom is a loss of activity in the trout. The individual becomes weak and is not ambitious enough to stem the current of the pond, and perhaps allows it to drift him against the screen at the lower end. He does not attempt to avoid the net and is easily taken. He still remains right side up, breathing quietly. He is apt to make spasmodic efforts to swim, but does not go far and turns partly over in the attempt. This is the beginning of a loss of equilibrium, which becomes complete, and the trout lies on his back or side at the surface or bottom, gasping. After occasional proxysms or frantic dashings in apparent great distress, death soon occurs.

Examined post mortem these trout have not fallen off much if any in condition. More than half of them have no external marks of disease and these look like fine healthy fish. But some have very plain external lesions, the essential feature of which is an extravasation of blood into the tissues. It is seen chiefly in the muscles, and appears in its simplest manifestation as a mere red streak or patch, or bloody blotch, while its ultimate or extreme condition is an ulcer. All intergradations between these two stages may be seen. That is to say the blotch of blood commences to liquefy the muscle surrounding it and the place becomes soft to the touch. It swells slightly or considerably, and may make an elevation or puffy swelling which looks like a pustule or boil. This is usually red or purple in color and rather soft or yielding, but sometimes slightly tense when the skin remains firm, showing the existence of some pressure from within. These are found on comparatively few of the dead fish as they usually die before reaching this stage. The skin finally sloughs and makes an ulcer. The location of these lesions may be anywhere on the trout, but favorite places are the bases of the fins, most often the pectoral, and the sides of the head. There are but few internal evidences of disease visible to the naked eye.

These boil-like elevations are not boils nor abscesses proper, for they do not contain pus and the infection is not a suppuration. Their contents are a bloody liquid which consists of the serum of the blood, some red corpuscles and a good many white ones, degenerated muscle fibres, and countless numbers of bacteria. There is no excess of white blood cells as would be the case if pus were present.

The disease is extremely fatal. Usually if the fish remain in the pond in which they acquired the disease, the death rate continues, the number dying each day becoming fewer as the school grows smaller, until the last one has turned his belly upward.

Now, what is the nature or cause of this mortality? Is it merely a question of bad hygiene, that is, not a specific disease, but merely a condition due to the surroundings, or food, or unsuitable circumstances? The fish cultural conditions are all that care and the application of the most approved methods can make them. The disease is not a mere matter of hygiene but is an infection, i. e., parasitic. Living organisms, foreign to the trout, have obtained a foothold, inhabit and grow within the body of the trout and at its expense. The blood and local lesions of the affected trout contain bacteria, in some cases in great numbers, and the infectious agent which causes all the trouble is believed to be bacterial. Proof is still wanting, but experiments are under way which I hope may furnish this.

But it may be considered established that the disease is an infection, which for our present practical purposes is the important point. It is caused then by a living parasite, an extremely small one,—a micro-parasite, which carries on operations chiefly on the inside of the fish instead of the outside. It is not easy to attack successfully the parasite in this position without doing violence to the fish itself, and I will put aside this part of the subject for the present. Prevention is worth more than cure.

Prevention suggests the question of the original source of the infection. Where did it come from, how did it get into the trout, and how may it be kept out? The original source is perfectly obscure at present, and may always remain so. The presence of the infection is more apparent than its origin and destiny. Yet there are some general considerations which have a bearing. There was a time, at Northville for instance, when these epidemics did not occur. It is unlikely therefore that the specific germs were normally and constantly very abundant. They were either constantly present in the environs of the ponds in small numbers, or at some time they became temporarily numerous. In the former case their constancy, in the latter their numbers, enabled them to gain the foothold in the brood of fish. Of course the virulence of the organisms is another factor which enters in. The foothold is the important thing. Now, where were these germs before they got inside the trout. The air contains many bacteria. But it is the less likely hypothesis that they dropped into the ponds from the air and then found their way into the fish. There is the soil and water, and if either of these it is of course ultimately the soil. This is a more reasonable supposition. Books on bacteriology have long lists of species of soil organisms. It is readily conceivable that some of these species, in the earth immediately surrounding the springs, conduits, or ponds of a trout hatchery entered the water and lodged within the body of a trout and found its blood and tissues so favorable a home, that whether or not it had ever been parasitic before, it now became so. It is readily seen that the mouth would be a probable avenue of entrance. The germ having entered the water is apt to be taken in with food of any sort. It is smaller than most of the body cells and can make its way into tissues between these cells. It can enter through abrasions anywhere on the exterior of the fish, through breaks too small to be seen, possibly through the intact skin. Theoretically one bacterium and one trout are sufficient for the start. The rest is easy.

It appears probable then that the original infection was not present in great abundance, but was comparatively dilute. But after occurrence of one epidemic the conditions are very different. When a brood of trout in a pond is affected with the disease, the specific germs must be thoroughly distributed about the pond. Wooden or earth ponds are pervious. They harbor the germs, and afford a permanent resting place in which they not only live but doubtless multiply, feeding upon the organic matter which is retained from uneaten food and exereta from the fish. The infection is now localized in the pond, it has a focus there, is no longer dilute, but is present in strength, and the fate of the next brood of susceptible fish placed in the ponds is almost a foregone conclusion. These ponds are incapable of thorough disinfection.

This brings us to what I may call the wooden pond theory. Wooden, because the ponds have usually wooden linings, but earth or other pervious material comes in the same class with wood for present purposes. The idea is merely that a pervious pond retains the infection indefinitely and passes it to the fish held in it. I believe no brook trout have been raised successfully in such a pond after this disease has once occurred in it. Now, if these ponds are built of an impervious material, cement, masonry or iron, this source of infection is cut off. Bacterial or other micro-organisms will not penetrate such material and can at most lodge along its surface. Here they may be readily killed by methods of chemical disinfection, which is practically impossible with the other ponds. It is to be understood, of course, that there is no magic in the cement itself to prevent disease any more than in the wooden construction to cause disease. The cement will act merely as a barrier to the invading germs, while the wood or earth on the other hand are their very vehicle. Our pond of masonry or cement then can reasonably be expected to prevent the spread and continuance of a given epidemic. It corrals it, so to speak, within a definite space, where it is vulnerable and may be killed by the ordinary methods. I am referring now of course to the germs in the pond but outside the fish. We can be sure of starting in any given case, with a clean, uninfected, or disinfected pond, and if infection enters thereafter it must gravitate from the air, or come down with the water supply.

We must consider briefly that part of the fish cultural water system above the ponds,—the part usually not inhabited by the fish. You will remember I made a distinction between the danger of the primary or original menace of infection and of the secondary or localized one. The former was looked upon as less dangerous but was responsible for the first epidemic, the latter as far more dangerous and almost certain to infect, and implied the continuance or recrudescence of the disease. This distinction corresponds on the one hand to the water supply above the ponds and free of fish, and on the other hand to the pond system itself in which the fish are held. The demarcation is at the point of entrance of water into the pond. Below this line, or in the ponds, the danger of infection is the same as that above plus the localization from previous epidemics. Bacteria probably do not travel up the conduits, so that above this line of demarcation the danger is that which always existed there, namely that some obscure chance or accident may start the ball of disease rolling by introducing infection into the water. At this point it may occur to you to ask why, if the cement construction is a barrier to infection, can it not be continued up the conduits and into the springs and make the water system impregnable? The objection will as readily suggest itself. As far as the conduits are concerned this would be excellent, but when it comes to the spring that of course must be left sufficiently open to deliver the water. These openings would defeat the main purpose of the cemented spring. It is a case of a little leaven leavening the whole loaf. The cement here might be of some value, but if infection underlies the spring the water would carry it in. If the water entering a cement lined spring could be filtered free of micro-organisms there would be complete protection in association with cement ponds from infection through soil or water. But this degree of safety cannot be attained. As for the prevention of disease by the use of cement or stone, we must count on the application of these to the ponds alone as so nearly covering the whole source of infection as to offer reasonable hope of accomplishing the prevention. This means that the pond infection is so large a part of all the infection to which the trout are exposed, that protection from it will mean protection from disease,—except, no doubt, the occasional outbreak. The danger of an occasional outbreak is a risk which must be assumed. At Northville, during the past June, the fry in the troughs in the hatchery commenced to die of the disease which was among the yearlings in the ponds out of doors. This is the first time in some years that serious trouble has occurred with the fry in troughs, and perhaps the first occurrence of this particular disease in the troughs. At first this seems to militate against the pond theory, for the trough supply water comes directly from a large spring above the ponds. But this spring is practically a fish pond, for trout have been kept there from time to time, and while disease has not been noticed there it is not improbable that it has occurred. There is always considerable loss from such ponds, part of which is due to depredations. But it must be remembered that fish dead or dying from disease would be apt to be quickly appropriated by birds and animals, or to be lost to sight in the vegetation, the conditions in this respect being quite different from the small wooden ponds where every fish is in plain sight at all times.

I do not forget that the source of disease may be looked for in quite other directions than the one I have indicated. The food would perhaps be the first to come under suspicion. It is very difficult of determination for the food which causes disease is long past examination by the time the disease is manifest. Daily examination bacteriologically, of a large number of rations, while involving a large amount of work, may be undertaken to advantage when the more probable explanation is discredited. Organisms to which the brook trout is susceptible can hardly be habitually present in the livers fed, or the disease would be more widespread than it is.

Thus far in considering the subject it has been assumed all along that the parasitic organism invades the trout from without, that is, is external to the fish. Now it may conceivably be a permanent resident within the trout, even performing some normal function, and not really foreign to it, though I expressed it that way, and when the vitality of the trout is lowered, or the susceptibility increased, under the conditions of domestication, it becomes a virulent parasite and destroys its host. A somewhat analogous instance may be cited in man. The colon bacillus is a normal and constant inhabitant of the human intestine. It ordinarily does no harm and formerly was not reckoned a disease producer. It is now known to be frequently concerned in pathologic process. The intestines of the brook trout of course contain always many bacteria, and it appears that the blood sometimes does in apparent health. The identity and significance of these organisms is little known at present. The question cannot be taken up to advantage until by experimental inoculation a specific bacterium is established as the cause of this trout disease. It will readily be seen however that should this hypothesis prove true the disease is much more serious than at present appears, and that cement ponds will be quite useless in combating it, unless they happen to be more hygienic. The matter of prevention would then resolve itself into a question of hygienic conditions and keeping the broods in a high state of vigor. Presumably this is best accomplished by imitation of the natural conditions, and with this domestication is largely inconsistent, because there must be considerable divergence from natural conditions.

As for a remedy for the disease, to apply to trout actually affected, I have none to offer. It is not probable that any will be found. In many human infections the best that can be done is to give the patient the best chance possible to fight it out by himself. There are very few specific remedies. The antitoxins are notable instances, particularly diphtheria antitoxin, which is a conspicuous triumph of medicine. These will probably not be applicable to fishes. When a trout shows external signs of the disease, he is doomed, and many are before such signs appear. However I have used formalin three different times in dilute solution as a bath. The idea was that there might be a germicidal action through the gills, but it was scarcely hoped that it could accomplish cures. Formalin is an aqueous solution containing 40 per cent. of formaldehyde gas. The bath contained one-third of 1 per cent. formalin or a little more than one-tenth of 1 per cent. formaldehyde. Fry endured this without injury for about five minutes, yearlings for about ten. On the first occasion there was no immediate falling off in the death rate, but after some weeks the infection subsided and a portion of the brood survived. It was an open question whether or not this was due to the treatment. On other occasions it was applied to fry and the death rate went up instead of down. I conclude that this sort of medicine is useless, and do not believe that any treatment is of any avail. The cure is nothing, the prevention everything.

At one station the disease was checked by the transfer of the trout to certain large earth ponds which contained an abundance of natural vegetation. In fact most of the conditions to which wild trout are subject were supplied by these earth ponds. They were very much larger than the wooden ponds. Now I believe there was more prevention in this than cure. The unaffected individuals merely failed to take up the infection, and the chief factor that enabled them to avoid it was the *dilution* of the infection, and the previous freedom of the pond from infection. It was somewhat like returning the trout to a natural stream. They separate, there is more space between the individuals and there are fewer germs to each cubic unit of water. Many fish within a small space is of course a necessity in domestication. This is a very important factor in the transmission of disease, perhaps the determining factor in its control. The fish are crowded from the standpoint of disease though not from that of aeration. One naturally wonders whether wild trout ever suffer this disease. The attempt has been made to follow the history of trout distributed from the hatchery, but no evidence of mortality could be obtained. In the wide range afforded by the natural streams lies the safety of the wild fish. Yet it will not be very surprising if the disease is sometimes found in the trout streams.

This remedy, then, is probably a preventive remedy. It is difficult to believe that any with the disease well established could have recovered. It is a success, nevertheless, so far and so long as it is able to check and prevent this disease, and it has done so in the few instances in which it could be applied. But such ponds as these must of course be limited in size and their ultimate infection is extremely probable, if not certain. They will then propagate the disease instead of checking it.

There is a class of predisposing causes. The explanation, or rather supposition, concerning the original entrance of infection regards it as a comparatively rare accident, and attributes it to no factor which could have been readily foreseen and controlled. A number of such factors have suggested themselves as possible explanations of the trouble with the brook trout:—food, water, lack of aeration in the water, in breeding, and the general artificial conditions which may be summed up as continued domestication. Some of these could actually convey infection, as the food or water, and predispose at the same time. But the others are predisposing causes only, where they have any influence at all. They are not efficient causes. The distinction is an important one because on it may hinge the future of brook trout culture. As for inbreeding there is probably no such thing in the sense of close consanguinity in which it is used with higher animals. If water should lack slightly in aeration, if hard water is of any disadvantage, if small ponds without vegetation are unfavorable, none of these things would express itself as an infection. But they could, singly or combined, predispose to such infection, and might be so important as predisposing causes that they determine the attack of disease. But the predisposition and the presence of disease germs must coincide. It is proposed to bar out the germs. It is hoped that cement ponds will be an adequate barrier. The predisposition will remain. It is hoped that the brook trout will thrive in spite of it.

Until this year, as far as I know, the disease in question affected only the brook trout. Now the Loch Leven has it. But the rainbow in ponds alongside and under identical conditions, has never acquired the disease, and seems to be immune. This is the only explanation I can offer, that of immunity. It is a matter of lack of susceptibility. This is a sufficient explanation for there are plenty of similar cases among higher animals, in which closely related species have very different susceptibility to the same disease. The immunity may not be complete, and the disease may sooner or later establish itself among rainbow trout.

The fact that many places where trout are bred and held in wooden ponds have not experienced the disease is only an apparent objection to the explanation of its cause as here given. It merely means that the germ is not present in the vicinity or has not gained a foothold in the ponds and in the trout. If one were permitted to inoculate these ponds or trout with material from diseased trout it would be surprising if the result were not the establishment of the disease there.

In the light of the facts at present known about the brook trout disease, its infectious nature, the experience of the United States Fish Commission with it, and the general principles that obtain in analagous diseases of the human family, it is submitted that the theory of pond infection is the most probable of the possible explanations of its regular recurrence; and that while impervious ponds are not proven to be the best and only way of dealing with the trouble—experience alone finally settling that—they are worth installing on an experimental basis.

DISCUSSION OF PROF. MARSH'S PAPER.

The President: We are greatly indebted to Mr. Marsh for that paper.

Mr. Clark: I think that the people here who have had any experience in the way of fish diseases should relate them and that there should be full discussion of the paper, any questions that may occur to us on this subject being directed to Prof. Marsh.

Mr. Bower: Prof. Marsh rather intimates that where the trout have access to the earth, or where the pond is filled with an abundance of vegetation, while this is not exactly a cure for disease, it may prevent it, and yet he prescribes as a remedy that we build cement ponds. This of course would cut off access to the earth and prevent the growth of vegetation, and while this might cure some particular form of disease or destroy some particular kind of parasite, might it not also encourage the development of other parasitic forms which the presence of vegetation would have a tendency to correct or prevent?

Prof. Marsh: It is a matter of experience that earth ponds actually did prevent the disease. That is, at a particular station the disease was in existence in a small pond, say an eighty foot pond lined with wood in the ordinary way; a great many of the fish were dying there every day; and the prospect was that in a short time they would all be dead; but we took them and put them into one of these large natural ponds which had been dug out, but which contained no wood, cement or stone in it, and the vegetation grew much as in an ordinary pond. It had all varieties of temperature, being fed with springs, and near the springs the fish could get as cool as they pleased, while at the top of the pond the water was as warm as could be desired, and there was a variety in temperature. These trout did not all die and the disease was checked. I do not think the earth cured any of them that already had the disease but it stopped the spread of the disease. The disease had existed in a pond not much larger than this room, and there was every chance for the disease to spread; but when the fish were put in the large pond they were widely separated and while there were fish that had the disease, no doubt, yet they did not pass it on to the rest and they got well. Now if that could be applied at all the stations where this disease is found and the fish could be turned over into such ponds, it would work well at least for a time, but, as I said in the paper, the infection even of such a large pond as is mentioned is merely a matter of time in my opinion. When the mud at the bottom of the large pond once becomes impregnated with the germs that have been carried over, the large ponds instead of checking the disease will spread it, and when you do get one of those large ponds infected you will never get the infection out; it is much harder to disinfect the large ponds than the small ones, for you cannot disinfect them with chemicals. The cement pond acts merely as a barrier against infection, and, as Mr. Bower says, it might in some way predispose to other diseases; we do not know about that. It is untried and the experiment must be made. I do not see how it could predispose to some other disease than the one we are trying to prevent.

Mr. Nevin: At our Bayfield hatchery we built a race ten by two hundred feet, and we had such a good stream of water running through, that with all the fish we handle during the spawning season, we hardly lost a trout till the middle of May; but from that time to the middle of June we lost a good many. We held the narrow race responsible for this loss at the time. We now have large ponds but we have the same trouble with them as with the smaller ponds. At the Madison hatchery we have the largest loss of fish in one of our best ponds in point of water supply, while in a small stone pond, with a limited supply of water, we carry more fish than in any other.

Mr. Arthur Sykes: Prof. Marsh, in speaking of the case where they transferred fish from an infected pond to one which was not infected, said the disease abated and that is the experience we have had several times at Madison, that transferring to another pond seemed to stop the disease, and that is true not only of fry but of yearlings.

The President: Do you know whether down in New England among those commercial hatcheries where they use peat for the sides of the ponds, they have had any difficulty with this disease or not?

Prof. Marsh: I have been told that those commercial hatcheries in New England have never had the disease; that they are able to raise brook trout successfully; and I understood that their ponds were much the same as the ordinary wooden ponds except they were of peat.

Mr. Clark: These fish, that Prof. Marsh has been working on were from eggs bought from the eastern hatcheries (the yearlings and the fry).

Mr. Bower: There are only one or two hatcheries that use peat, but they use either peat or wood.

The President: None of them have stone or cement; they are all natural earth banks or they are wood, and yet they never have the disease.

Prof. Marsh: Of course that seems strange, but there was a time when the disease did not occur in these wooden ponds. The infection has got to occur there after a certain length of time—it will come.

Mr. Brown: I would ask, where they have the wood pond, if the wood was not treated with some kind of paint that made it impervious to germs—creosote or coal tar?

Prof. Marsh: That is practically proposing to make the equivalent of cement. If you can put wood in the ground and make it impervious, well and good, but I do not believe that you can do it. You can make an impervious box or bank above the ground, but if it is in the ground how can you protect it from being heaved by the frost? It would be very difficult, you see, and rather difficult to make it tight. In this climate I suppose it would be upheaved the first winter by the frost, and that is possibly an important objection to the cement or stone ponds; I cannot find where they have been experimented with during hard winters.

Mr. Clark: Was this question brought up by Mr. Brown in regard to the wood ponds, that if they were properly coated with something that that might be a preventive of germs?

The President: Yes.

Mr. Clark: Prof. Marsh has not touched upon that. But the disease now, as he says, has developed in ponds having cement sides and no wood. That helps to carry out the theory that this disease works in. I now have orders from the commissioner to build two ponds in accordance with Prof. Marsh's suggestions, that is, entirely of cement, bottom, sides and ends. The water goes through nothing but cement tile. We thus hope to avoid the possibility of the introduction of germs. Four of our present ponds have cement sides but not cement bottoms, so the theory of the painted wood sides cannot figure in this matter, as cement sides are certainly as effective as painted wood in keeping out disease.

Mr. Nevin: We have never had any loss among the small fry or yearlings, but our loss has been among the largest trout.

The President: Those that have been in the pond longest.

Mr. Nevin: At Bayfield we do not have the loss until the spring of the year. The water goes down to 33 or 34 degrees and as soon as it begins to warm up in the early summer our loss commences. At Madison we have our greatest loss in January and February while in Bayfield it is in May and June.

Prof. Marsh: Mr. Clark's experience is that this disease affects yearlings especially and that he has never had it in the adult crop. The yearling appears to be especially susceptible, but later the disease attacks the fry, and we have never had it in fish over two years old. It comes in yearlings more than in other fish.

Mr. Mathewson: In Connecticut we lost lots of our fry in the troughs before we got them out into the ponds at all—lost them by thousands—and we were using the same water as with yearlings, but we did not lose any of our yearlings. We have not been able to account for this fact.

Prof. Marsh: Was it brook trout?

Mr. Mathewson: Yes, we lost thousands of fry in the trough.

Mr. Titcomb: We have not had what we call an epidemic either at the state hatchery or the national hatchery, but we have had in two or three instances cases where the fry in one trough supplied with water from the supply trough would turn right over and all die, where the fry in the other troughs right next to them would be strong and healthy and go through all right. We could not account for that.

Mr. Mathewson: That was our experience this year.

Mr. Sykes: The change of environment has brought them out all right at Madison. Even a fry that is a little weak, when taken out into the pond receiving water from the hatchery, comes out all right. The change of environment seemed to be what was required.

Prof. Marsh: There was no greater amount of water but more room.

Mr. Sykes: That is true. There was a different bottom, as they were taken from a gravel bottom and put on a mud bottom.

Prof. Marsh: There might be something I suppose in mere change.

The President: This discussion is very interesting to the Michigan Fish Commission, because we have just secured an appropriation to build a new hatchery, and they have not started it yet.

Prof. Marsh: I would like to ask the gentleman who spoke about Connecticut if he noticed in those fry that he was talking about, the appearance of the dead ones. Did they look like healthy fry?

Mr. Mathewson: They appeared to be perfectly healthy. They seemed to start and go all at once; I took them to the state chemist at Yale college and he could not explain it.

Prof. Marsh: You examined the dead fry and their sides and muscles seemed to be all right?

Mr. Mathewson: Yes, except a little dark streak through the intestines.

Prof. Marsh: No ulcers or sores?

Mr. Mathewson: No.

Prof. Marsh: That might have been a different disease than the particular one that we are discussing.

Mr. Mathewson: This was just as they were beginning to feed—they had been feeding about two weeks at that time.

Mr. Geer: I would like to ask if that disease would affect the hatching troughs also so as to kill the fry?

Prof. Marsh: We have had the disease in fry that were in troughs, but very much more rarely than in the ponds. This summer for the first time it occurred in the troughs. The troughs in the house, as far as protection from germs is concerned, are on just the same basis as cement ponds out of doors. They are painted with asphalt all over and are perfectly impervious. So I explain their infection on the ground of original and rare infection from the springs, and that should be excluded. If you could continue impervious construction up into the spring, it would be advisable to do so, but you cannot do it, so that once in a while this disease will attack trout even in cement ponds under the best conditions, but you can nip it in the bud, whereas with wooden or earth ponds the infection is carried on forever; it rests in the organic material, soaks into the wood, and multiplies in this organic matter which always exists, and disinfection is impossible. But in the cement ponds disinfection can be readily accomplished, and you can start over with your pond perfectly clean. Now if this original infection should occur every year you are as badly off with cement ponds as you are with wooden ponds, but happily this original infection will probably be comparatively rare.

Mr. Sykes: Where diseased fish are put into another pond they must leave the germs of the disease in that pond.

Prof. Marsh: Yes, sir.

Mr. Sykes: You put diseased fish into earth ponds?

Prof. Marsh: Yes.

Mr. Sykes: Your idea is that the soil becomes polluted with this disease germ, yet in the nature of things that must leave the new pond in the same condition.

Prof. Marsh: It has not done so yet, because it has not had time. The large earth pond would be infected more slowly because of its size.

Mr. Sykes: Your idea is that these disease germs multiply in the soil and do not tend to die out?

Prof. Marsh: In a plain earth pond or wooden pond the tendency is for them to grow. The water soaks in through the boards and there is nothing but a wet mush full of organic material, and they will grow in that, but in a natural pond of vegetation I think there is less chance for it, because it is not quite so rotten down there.

Mr. Sykes: You make a distinction between an earth pond with vegetation and a board pond without vegetation?

Prof. Marsh: Yes.

THE STUDY OF FISH DISEASES.

BY CHAS. G. ATKINS.

It is not my purpose in this paper to present an exhaustive discussion of the subject, nor even a general summary of the results of investigation in the field. I shall attempt the humbler task of citing a few passages from my experience, perfaced by some general observations which I trust may commend themselves to your approval.

While for the complete elucidation of the nature of the diseases of fishes, as well as those of the human race, we must call to our assistance the professional microscopist and the professional pathologist, it is not at all necessary that the lay fish culturist should lie on his oars while epidemics or diseases of more limited scope sweep away his charges. It is quite within his province to observe, to record, to experiment, and quite possible thereby to learn very much about these diseases and the means of their avoidance, control or cure. But it is quite essential that any one attempting such studies should adopt the scientific spirit, and the scientific spirit demands the exercise of great earnestness, great alertness, great patience, great perseverance, and above all great self-control. And when I say self-control, I mean especially control of the opinion, restraining one's mind from making itself up prematurely,—on insufficient data. To put it in more popular language, one must not jump at conclusions.

I may be pardoned for digressing here far enough to say that in the course of a lifetime spent in this pursuit, I have often had occasion to note that the bane of fish culture has been the disposition to jump at conclusions. It is a trait of human nature. Hardly one of us is free from the foible, and hardly one of us but is suffering today from the effects of some mistaken conclusion reached in the past by disregarding some pertinent facts that, if not plainly in sight, might have been easily brought to view by a little more of persistence in the search. Private fish culture and public fish culture are suffering from it today. There has been too little of the scientific spirit. And science, I beg to remind you, does not consist essentially in a knowledge of the Latin names of fishes or the minute anatomy of an insect. Such things are not to be despised, but they are only aids and means to something of greater importance; and a man may possess either or both of them and yet be less scientific than a humble layman who holds his eyes and his mind open for the acquisition of new facts, and faithfully restrains his opinions from crystallizing on any half-knowledge.

I think that the importance of this subject is generally underestimated. It is not impossible that many fish cultural operations have been brought to naught by the action of unrecognized diseases; nor that definite diseases have been the cause of many of those great fluctuations in the numbers of wild fishes that history has recorded.

Hardly any of the great commercial fishes have escaped fluctuations, either general or local, which have been of great moment to mankind. Not only to the fresh-water and anadromous species, but to those of the ocean, will this statement apply. For instance, the sudden disappearance of the tile fish some years ago from the grounds where it had been abundant, followed after years by its reappearance; the fluctuations of herring on the coast of Sweden; of the blue fish and menhaden on the coast of New England. Some of these phenomena may be accounted for in other ways, but the tendency of discovery is in the direction of some destructive enemy or disease to account for very sudden decrease of species.

An official report lying before me gives a list of 104 different diseases from which human deaths occurred in the state of Maine during the seven years from 1892 to 1898. Is there any inherent reason why fishes should not have as many diseases as men? Observation has already gone far enough to indicate the probable existence of a very considerable number of diseases among the fishes we cultivate. At the Craig Brook Station of the United States Fish Commission there have been observed perhaps a dozen different diseases affecting salmon and trout, the majority of which still await sufficient study to warrant us in naming them or assigning definite causes. A rough list of them, not pretending to be complete or exact, is as follows:

1. A spot disease of the sac, appearing in the egg or after hatching.

2. A disease appearing when the sac is about half absorbed, characterized by a whitening of the sac, which begins in irregular white blotches: our most serious disease, known locally as the "sac-epidemic:" attacking several species.

3. Another disease of the sac stage, characterized by a strong upward curvature of the trunk.

4. A disease of the dorsal fin of a salmon in the first summer of its life, in which the fin is eaten away at its edges until more than two-thirds gone and then heals up perfectly, with no other apparent injury to the fish.

5. A similar disease attacking the fins of young rainbow trout and steel heads, especially the caudal fin, which is completely eaten away, together with the adjacent flesh, until the extremity of the back bone is bare.

6. Fungus on the egg.

7. Fungus on fry two to four months old.

8. Fungus on adult salmon.

9. Monstrous enlargement of the genital organs of salmon in their second year.

10. Trematode parasites on young lake trout.

11. An epidemic attacking salmon two or three months old.

12. An epidemic attacking salmon four or five months old.

13. A sort of epilepsy in which salmon two or three months old have temporarily lost their balance.

One of the most interesting cases was that of the young lake trout attacked by parasites in 1896. These fish had been hatched from eggs received from Northville and had apparently been thriving until about the middle of July, when there was a slight increase in the mortality. A week later the rate of mortality had trebled and by the 10th of August it had increased more than tenfold. At first it was thought possible that the mortality was due to fungus, and the fish were treated with salt. No benefit resulting, the microscope was brought into use and behold the fish were swarming with living, active parasites, which moved about over the fish after the manner of loop-worms or leeches, apparently the creature that has been described under the name of Gyrodactylus elegans. In hope of destroying the parasite, the salt treatment was continued, but it was found at last that the parasite could endure quite as much salt as the fish itself. Mr. Seagle at Wytheville, has since discovered that this parasite is readily destroyed, with entire safety to the fish by a bath consisting of one part common cider vinegar, three parts water. The mortality went on until the sufferers had shrunk from 39,000 July 1st to 10,000 in November, and the survivors were fish of low vitality, of whom probably not one ever grew up.

No unusual mortality occurring among the fishes of other species reared alongside the lake trout, and under the same circumstances, it was a puzzling problem why the Gyrodactylus had made such an attack on the lake trout. The theory was at once suggested that the parasites had been imported along with the eggs, and the occurrence of a few specimens on other fishes in neighboring troughs might easily have been accounted for on the supposition of accidental transfer from trough to trough; but the discovery of specimens on wild fish caught in Craig Pond at the head of Craig Brook, more than half a mile distant, with intervening falls of great difficulty, indicated that the parasite was native to our locality, and suggested that something extraordinary in the condition of the lake trout invited the attack. Indeed it seems not impossible that the fish died from some other cause, —some unknown disease,—and that the parasites had merely been feeding on the disintegrated tissues. Verily, this is a case in which judgment must be suspended.

The most destructive disease that has ever come under my observation was the sac-epidemic which raged several seasons at Craig Brook and in 1892 destroyed 99 per cent. of our young Atlantic salmon. I call it "sac-epidemic" because it raged during the sac stage of the fry, and because the most obvious symptoms were connected with the sac. It would appear about midway of the sac stage, while the sac was still less than half absorbed. In water of constant temperature, such as pure spring water, I imagine that the disease would appear by the first quarter of that stage. Our water is very cold at the time of hatching —about April 1st,—and gradually warms up, so that the development of the embryo is at first very slow and later comparatively rapid. The fry hatch about April 1st, and before the end of April, in epidemic years, the mortality suddenly increases, and it is found that the sacs of the fry are blotched with white. These blotches spread until the sac is nearly all white, especially the apex. When it reaches this stage, the fish dies. Other symptoms are apparent listlessness, indifference to light and outside movements, and in consequence a scattering about on the bottom of the trough instead of crowding into the dark corners as is the normal habit of the fish.

This disease was first observed in 1890, when it carried off 30 per cent. of our fry, including Atlantic salmon, and land locked salmon, but did not touch Loch Leven trout or Swiss Lake trout. It was, however, observed that not all of the Atlantic salmon were attacked (or at any rate suffered noticeably) and in the lots where it did appear its destruction was quite uneven, in some cases barely noticeable and in others wiping the lot completely out.

It is our practice at the Craig Brook Station to preserve a careful record of the character of every salmon handled at spawning time, to keep the spawn taken each day separate from that of every other day, and to keep up the distinction with the fish hatched through the entire season, and indeed as long as the fish remain with us. In some cases, as, for instance, a female salmon of remarkably large or remarkably small size, or an unhealthy appearance of fish or eggs, the product of each fish is kept by itself. The position of each family in the hatchery is also noted. When hatching time approaches, the large lots of eggs, (or families), are divided up into smaller lots of one or two thousand each,—sometimes larger—and the origin, location and history of each of these minor lots is recorded. When therefore, one of our fishes dies, or does anything else remarkable, we are able to follow back its record to the day when as an egg it rattled into the pan at Dead Brook, and sometimes to the identical mother that dropped the embryo and the identical father that gave the initial impulse of life. These records sometimes appear, even to us who keep them, as somewhat laborious and fussy, but in this instance of the sac-epidemic of 1890, they have enabled us to draw some very interesting conclusions as to the influence of heredity in this disease.

It happened that the troughs intended for the summer use of these fish were not quite ready when the eggs were laid out in March to hatch, and they were therefore crowded for hatching into a smaller number of troughs which were for the purpose divided into compartments by fine, close-fitting wire screens. The water, passing first over lot A would nourish in succession lots B, C, D and so on down the trough.

One of the most noticable results was that the losses were very unevenly distributed in the troughs. For instance, Lot A, at the head of the trough, might be half destroyed, Lot B totally, and Lot C almost wholly escape. When all the results were correllated, it was found that the mortality ran in families, some families being utterly destroyed, some suffering moderately, while in others the mortality would be so light as to warrant the conclusion that the epidemic had nothing to do with it.

Now what shall we say? Did the germs of the disease come to these little fishes from their parents, or did they inherit merely different resisting powers, so that, though all of them were assailed about equally by the disease-germs, some of the families had a hereditary ability to ward them off, while others succumbed? The answer to this question must await deeper study than we have yet been able to give.

Among other deductions to be drawn from the same data is one as to the infectiousness of the disease. Infectiousness would cause the lots occupying the lower parts of the troughs to receive the disease from those lying above them; but the record shows that nothing of the sort happened. The rate of mortality of the lower lots was wholly uninfluenced by the condition of those above. It was therefore not an infectious disease, and did not spread from lot to lot.

It was further observed with reference to this disease, that the occasion of its first appearance was coincident with a great reduction in the proportion of lake water in the hatchery supply. A coffer dam had been constructed at the outlet of Craig pond (or lake) which in the spring shut off the lake water and compelled us to use a much larger proportion of spring water. A second attack in 1892, was coincident with a very low stage of Craig pond and brook, caused by a scanty fall of rain and neglect of storage measures. It therefore seemed reasonable to turn our suspicions in the direction of the spring water. Measures were taken to insure a fuller supply of lake water during the stage following and immediately preceding hatching, and this has been attended with favorable results.

I earnestly recommend all fish culturists to keep complete records, even to the verge of fussiness, so complete and exact that they can be intelligently referred to after the lapse of many years. Besides many other uses, they may serve to solve some of the puzzling problems connected with the diseases of fishes.

DISCUSSION OF MR. ATKINS' PAPER.

Prof. Marsh: The reference that the writer makes to epilepsy in fishes recalls to my mind an interesting instance of that disease occurring in the Snowy Grouper (epinephelus niveatus) in the aquarium at Washington. These fish had a peculiar attack of what one might term epilepsy. They became frantic and dashed about the aquarium at a tremendous rate. They looked as if they would die, and apparently they did die. Their mouths were wide open and gills distended; but they came to life again; and every now and then the fish in this aquarium would undergo the same experience, and did for all the time that they were there; and this was repeated a number of times, and this family of Groupers seems to be subject to such attacks of fits of epilepsy, and it is interesting to notice it in Mr. Atkins' experience.

Mr. Clark: Just before the reading of the first paper the attention of the superintendents was called to the importance of this subject. Its discussion has been very interesting to me and has brought out a great deal that is good.

General Bryant: Dr. Birge, of the State University, is studying with the greatest care and watchfulness all indications of disease that occur in our hatcheries, and I was in hopes that he would be here today—he may be here tomorrow—he is now president of our university and is so loaded down with administrative cares that he is compelled to be absent today at least.

Mr. Bower: Mr. Atkins enumerates in his paper thirteen different diseases. It looks to me as though the trout culturist has a pretty hard row to hoe, and it seems that new diseases are coming up all the time, or at least old diseases under new names, and it all emphasizes the necessity for great vigilance on the part of the fish culturist and the constant employment of a scientist to work on these subjects.

General Bryant: I secured legislation in this state some years ago to make the professor of biology in our university ex-officio a member of the Fish Commission, and the legislature fell in with the suggestion very readily. We considered it a very wise step to take at the time and experience has justified it.

THE PROPAGATION OF MUSKELLUNGE IN WISCONSIN.

BY JAMES NEVIN.

The muskellunge is the largest of our fresh-water game fish, and as he was endowed by his creator with great size, in like manner, he was given liberally of those excellent game qualities which appeal to the sportsman. From a gastronomic standpoint he has few equals among fresh water fish. To the frequenters of the great fishing resorts of Northern Wisconsin there is no attraction so great as the capture of this king of fresh water fish. His great size, vigorous game spirit, and superior table qualities combine to make him a prize worthy the effort of the most exacting disciple of Walton. Many anglers come for hundreds of miles with the one idea of capturing this fish, and few sportsmen are content to leave our northern waters till they have put at least one of these fine fishes to their score. The fish is worthy all the effort that is given to its capture; for, to say nothing of the pleasurable excitement incident to catching it, it has a table value not excelled by any other large fish of our fresh waters. By some it is properly ranked in quality next to the salt water salmon.

For many years, since the wilderness of Northern Wisconsin was opened by the railways and by lumbering operations; with the advent of the comforts and conveniences which the railroad takes into a new country, and the encroachment of the settler and summer hotel on the primitive banks of our northern lakes, the pursuit of the muskellunge has been constant and relentless. Its utter extermination has been well nigh accomplished in many of our lakes to which it is indigenous; and nearly all of our waters have been cleared of this fish to such an extent that its future has become a matter of much concern to sportsmen, fish culturists and others interested in keeping our waters well stocked with superior game fish.

Under these circumstances it has devolved upon the State Fish Commission to attempt the preservation and increase of muskellunge in our waters, and it is much to be regretted that this work was not begun several years ago.

The artificial propagation of muskellunge was first taken up by the Fish Commission of the state of New York some twelve years since, and in 1891 that state made the first successful hatch of this species, planting over 1,000,000 fry. Since that time the Fish Commission of New York has planted several millions of fry of this species in Chautauqua Lake and other waters with unqualified success.

The Commissioners of Fisheries of Wisconsin began the propagation of muskellunge during the spring of 1899 in connection with the work of collecting wall-eyed pike ova; and we believe we are now in a fair way to successfully hatch and plant the fry of this fish in large numbers.

The chief difficulty we encountered in this work was to catch the fish on the eve of spawning; as we found that the large fish would not stand confinement. In the beginning we could not get a sufficient number of ripe male fish. We tried holding the fish in pens, expecting that both the male and female thus confined would ripen in a few days, but in this we were disappointed.

Last year we caught the fish in pound and fyke nets and confined them to a large dummy or pocket, 20x22 feet, 10 feet deep. We were quite sure that we could hold the fish in this way until the ovaries ripened, but we were again disappointed; as we found the ova would cake in the fish and we were obliged to liberate them without securing the eggs we expected.

During the spawning season just past we made a large pen in a thoroughfare between two lakes, in a current of flowing water, in which we held the unripe fish. We found this pen a great improvement over the dummy for this purpose. The unripe fish placed in the pen matured the ova in due time and we were enabled to take spawn and milt from most of the fish secured. After spawning, the fish were returned to the water alive.

If you are searching for the spawning beds of muskellunge you should look where the logs, stumps and drift wood are the thickest. There you will find them, in season, attending to their procreative duties. They approach their spawning grounds in pairs and spawn in shallow water or flowage where dead limbs, logs, and brush have accumulated as the result of flooding for logging purposes or otherwise.

To catch the fish as they approach their spawning grounds is the strategy employed by the fish culturist; for it would be impossible to set a net where they spawn. For this purpose we now use only fyke nets, and as the fish are taken from the nets each day, if unripe, they are transferred ao the retaining pen until such time as the spawn may be taken from them.

It is not altogether an easy matter to collect a large number of muskellunge from our waters for spawning purposes; as it is necessary to cover considerable territory with our nets, setting them on the approaches to as many spawning grounds as possible. Many fish caught in this way are transferred four or five miles from the point where they are caught to the retaining pen.

In transporting the fish from point to point we use large live boxes (so called) sixteen feet long, two feet wide and ten inches deep. These boxes are made scow shape to facilitate towing them. The bottoms of the boxes are made of slats, nailed two inches apart, giving abundant circulation of water and enabling us to safely transport the fish in tow of a row boat to any reasonable distance.

During the season just past we secured 190 muskellunge from which we took 1,200,000 eggs; one female, weighing about forty pounds, producing not less than 225,000 ova. A quart measure will contain about 80,000 muskellunge ova.

Unlike most other fish, the eggs of the muskellunge do not harden after being taken from the fish but remain soft and flabby until hatched. With water at a temperature of fifty-two degrees the eggs hatch in about ten days, and about fifteen days are required to absorb the food sac.

Heretofore, we were not in position to try hatching muskellunge eggs in jars. This year our work was conducted in the vicinity of the Minocqua Hatchery, and I placed part of the eggs in Chase hatching jars at this station. The remainder, being more than half the eggs, was put in hatching boxes and sunk in some four feet of water. We hatched a very small per cent in boxes, but were more successful with the eggs incubated in jars. Just before the eggs began to hatch, we took them from the jars and placed them on trays made of fine wire-cloth. This was done to prevent the young fish smothering; for I found that the fry would not make their way out of the jars unaided on account of the comparatively large umbilical sac.

The fry when first hatched are of a light color and seem to adhere to the side of the tank, box or tray or any other object with which they come in contact. Those that we hatched were strong and healthy. They grew rapidly, and in their development exhibited their wild nature and the instinct of self preservation by quickly darting off to hide when alarmed by a person approaching the tank in which they were confined. We retained part of them until they were four weeks old and at the end of that time they were an inch and a quarter long. We fed them on young pike which seemed to be a suitable as well as very acceptable food.

We planted 500,000 fry.

I believe we are justified in claiming that our work in planting muskellunge fry during the past two years has shown results of a substantial nature. In the Minocqua waters, where we planted the fry hatched the first two years, more small muskellunge weighing from one to three pounds have been taken during this season than were ever taken before from those waters in the same period in the memory of the oldest guide or resident. We are gratified by the results of our first efforts in this work and entertain large hopes for the future. Already, in fancy, I see our lakes again teeming with this splendid fish, and the value of fish cultural work once more conclusively demonstrated in our waters.

Numerous lakes in Northern Wisconsin, the habitat of this fish, afford an extensive field in which to work, and, when once well stocked, these waters will be a source of abundant revenue to the state; for no other fresh water fish is so attractive to the sportsman and summer tourist.

DISCUSSION OF MR. NEVIN'S PAPER.

Mr. Bower: How long were the fish held in confinement before yielding up their ova?

Mr. Nevin: Some of them a week or ten days.

Mr. Bower: Our practice has been to catch the fish, spawn them and let them go as quick as we could.

EXPERIMENTS IN LOBSTER CULTURE.

BY DR. A. D. MEAD.

There is, in the life of the lobsters, a definite, well-marked period beginning when the eggs are hatched and ending when the young have shed their shells three times and have reached the fourth stage of development. During this period the young are very poorly equipped, either in structure or habits, for protecting themselves against their enemies or from escaping from them. They swim about slowly and aimlessly in the water, an easy prey to shrimps, fishes, and other animals; they lack the hard shell, the protective coloration, and the swift movements common to most small crustacea; indeed, they do not have even the sense of fear which might lead them to avoid danger. During this period of life there is, as might readily be inferred, a very great mortality.

When, however, the skin has been shed the third time and the lobsters have entered the fourth stage, there is immediately an almost miraculous change in their habits and structure. In many respects the difference between the fry in the third and fourth stages is far greater than between animals belonging to different orders, and the change may be compared to the metamorphosis of flying insects from their larval to their winged condition. In the lobsters, however, the direction of the change is the reverse of that in the insects. They tend to quit their swimming habits, except for purpose of changing position, capturing prey, etc., and become adapted to life on the bottom. They crawl over the bottom, hide under shells and sea-weed and, if these objects cannot be found, they even burrow in the sand.

A brief statement of one experiment will illustrate the suddenness of this change of habit. Three hundred specimens recently moulted into this stage were put into a car which had gravel and stones in the bottom. Within ten minutes not a single specimen was in sight.

Not the least remarkable of the altered characteristics of the fourth stage is their mental attitude. Upon entering this stage they are born again, they know good and evil; for the first time the sense of fear is evident, and they retreat from danger; there is, in short, a purpose and direction in their activities which was not apparent in the three earlier stages.

The suddenness and completeness of these changes so conducive to the safety of the lobsters gives much practical and economic interest to the problems of rearing the young through the critical period. The solution of these problems would mean a great advance in the efficiency of general propagation of lobsters, and would be the first step toward artificial lobster culture. With this in view a series of observations and experiments have been conducted during the past three seasons by the United States Fish Commission at Woods Hole, Mass., and by the Rhode Island Commission of Inland Fisheries at Wickford, R. I.

The problems in question can be arranged conveniently under five heads as follows:

1. What changes in structure occur in the early development?

2. What is the duration of the first three stages?

3. What are the general habits of life in the first four stages?

4. What is the best method of supplying food?

5. What is the best means of protecting the fry in the first three stages?

1. What changes in structure occur during the early development?

An excellent account of the structural changes from the egg to the fourth moult is to be found in F. H. Herrick's monograph of the lobster, and it will hardly be necessary to discuss them in this paper.

2. What is the duration of the first three stages?

The average period between hatching and reaching the fourth stage for the experiment at Wickford was a little over twelve days. In each experiment the average duration of the first three stages, meaning the interval between the time of hatching and the day upon which the largest number entered the fourth stage, varies from nine to sixteen days.

In experiments conducted at Wood's Hole the time required for these moults was considerably greater; of one lot, hatched May 23d, the fourth stage was reached by a few only on June 12th, after an interval of twenty days. Indeed, on the twelfth day (the average time of reaching the fourth stage at Wickford) none had reached even the third stage at Wood's Hole. The explanation of the variations in the length of time required for the first three stages probably lies in the difference in temperature of the water—the colder the water, the slower the development.

3. What are the general habits of life in the first four stages?

Allusion has been made already to the swimming habits of the fry in the first three stages and to the sudden change to the crawling habit when the fourth stage is reached.

The habit of shedding the skin begins when the lobsters are two or three days old and continues throughout life. The intervals between successive moults grow longer as the age increases. It has already been stated that the first three moults occur, in about twelve days, on the average, at Wickford. There is much variation, according to different conditions. Late in life the periods are longer, and the adult may not shed more than once a year. In the first moults, as in the succeeding ones, the process is the same, the old skin being split across the back, between the thorax and the abdomen, and the body worked out through this opening, leaving the cast skin otherwise intact.

The actual process of moulting usually occupies only a few minutes, but not infrequently something goes wrong and the struggle is quite prolonged. Often the lobster dies in the process, and the period of moulting is at best a very precarious one in the life of the lobster, whether in the young stages or in the later ones.

No animals, with the exception of typhoid convalescents, are more voracious than newly-hatched lobsters. They feed normally upon all sorts of minute organisms such as copepods, diatomes, etc., and will readily eat some kinds of flesh, if chopped into fine pieces and kept suspended in the water where the fry come in contact with it. Apparently they do not distinguish food sufficiently well to go to it from any considerable distance, but take what they come in contact with; and as they are continually moving about in an ocean full of organisms, they must but rarely want for food.

The experiments in rearing the fry through the critical period have demonstrated that the chief difficulties to be contended with are, first, that of supplying proper food; and, second, that of furnishing adequate protection.

4. What is the best method of supplying food?

When a large number of fry are kept in an enclosure, the natural food supply consisting of other organism, is of course not sufficient in quantity and other food must be introduced. Some method must be resorted to, which will provide the food in greater quantities and with greater certainty. The fry decidedly prefer an animal to a vegetable diet, and, while shrimp can be fed satisfactorily on bread, the lobsters will not eat it.

One of the best foods is lobster liver, which is readily shaken into minute short filaments. At the present price of lobsters this diet is rather too luxurious to be used on a large scale, and furthermore the experiments seem to indicate that it does not always agree with the fry. Shredded fresh fish is fairly good, and very satisfactory in the later stages. The best food so far discovered is the soft parts of clams. The bodies of the clam are cut out and chopped into fine pieces in a chopping tray and then thrown into the water.

There is one habit of the fry which makes the question of ample food supply especially important, their atrocious cannibalism. From the moment they are hatched, throughout the early stages of life their affection for one another takes this disgusting form. The only way to prevent them from destroying one another is to give them an abundance of food, and in such a manner that they will take it in preference to other lobster fry.

5. What is the best means of protecting the fry during the first three stages?

There are two main difficulties in the way of providing a suitable enclosure for the fry which will allow them sufficient freedom, and which will at the same time confine them and protect them from their enemies. The fact that the young fry swim about and are carried hither and thither by the currents constitutes the first difficulty, for when they are placed in an enclosure provided with a screen which will allow a free circulation of water from the outside, but shuts out the enemies, the fry are carried against the screen and die. The second difficulty is quite as serious and is due to the fact that at certain times the fry have a tendency to leave the surface and sink to the lower depths.

The endeavor was made to rear them in large cars, such as were used at Wood's Hole for holding cod, but provided, of course, with screen sides. This and other similar experiments failed, because the lobsters would be carried against one side by the tide and there gradually sink to the bottom, where they became foul with accumulated silt and unused food and were also apt to meet with death in fighting one another.

The apparatus which promised the best results was first tried by Prof. Bumpus in the summer of 1899. This consisted of large square bags made of scrim, fastened to a float, and weighted at the lower corners. The action of the tides and winds tended to keep the sides and bottom of the bag in constant undulating motion, and thus prevented the fry from lying long in one place, if they were inclined to sink.

This was the method which was almost exclusively used at Wickford during the summer of 1900.

After making numerous experiments and watching the results for about five weeks, we gradually came to the conclusion that the secret of success in rearing the young lobsters was to keep the water in continuous motion. This accomplishes two things: it prevents the fry from settling into pockets to smother or devour one another, and it keeps food in suspension so that the fry can obtain it.

To prove the correctness of this conclusion with the material and apparatus at hand, it was decided to experiment with lobsters which were at that time in small bags. Accordingly the force of the laboratory was divided into watches, and the water in the bags was henceforth stirred with an oar continuously for a week. The result was ample proof that the conclusion was correct. One of the most encouraging results of this method was the clean and healthy appearance of the fry in all stages. The continual stirring prevented the accumulation of parasites found on the body of nearly all of the specimens in the other lots.

Such good results led us to follow up this experiment with others, working upon the same theory, namely that the water should be constantly stirred. To do this a mechanical device has been contrived which takes the place of the oar.

This apparatus, which was put into operation at the beginning of the present season at the floating laboratory of the Rhode Island Commission at Wickford, has proved to be very efficient and a brief description of it may be of interest.

Cylindrical cages, about five feet long and four feet in diameter, made of fine meshed netting were used to contain the newly hatched fry. On the inside of the cage near the bottom was set a two bladed propeller which could be rotated by a vertical shaft. When the propeller was slowly rotated the water was forced gently upwards and the fry, together with particles of food, were kept constantly suspended. In our experiments twelve of these apparatus were operated by a small gasoline engine. The propellers were kept constantly in motion day and night throughout the season. When it was necessary to change the lobsters from one cage to another or to put in a new experiment any of the propellers could be easily thrown out of gear.

The results obtained by the use of this apparatus were certainly very gratifying to anyone who is at all acquainted with previous experiments along this line. In order to ascertain exactly what proportion of the fry could be reared, they were carefully counted one by one at the beginning and at the end of each experiment. From 1,000 to 5,000 of the newly hatched fry were put into one cage and the percentage reared to the fourth stage was in no case less than sixteen except in one case when the bag was torn and the fry escaped. One experiment yielded 34 1-2 per cent., one 40 per cent., and one of the later experiments 59.6 per cent.

Though a comparatively small number of experiments were tried a total of 8,996 lobsters in the fourth stage were obtained. These were placed in cages with sand or gravel bottoms for they no longer needed attention when provided with a place to burrow or hide and enough to eat.

A number of lobsters hatched last year were carried over winter in similar sand cages and are now from one and one-half to three and one-half inches in length.

As a conclusion drawn from these experiments I think it may be asserted not only that we have discovered the right principle in the solution of this most difficult part of lobster culture but that the problem is actually solved. For in view of the enormous mortality of the fry in the early stages, it would be conservative to say that even ten lobsters in the fourth stage are of more significance in lobster propagation than 100 lobster fry newly hatched, and a yield of 30, 40 or 50 per cent. is better yet.

PRACTICAL HINTS ON FISH CULTURE.

BY DR. JAMES A. HENSHALL.

In the conduct of any operation the smallest matters are often the most important, and too much care and study can not be devoted to seemingly unimportant details. Very often, also, the simplest devices give better practical results than those of more elaborate and complicated structure.

In fish culture, especially, is this true, and the more we endeavor to follow the methods of Nature, and rely on the simplest means to that end, the greater will likely be our success. Therefore, while the following suggestions may embody nothing not already known to some or all fish culturists, they are none the less true and worthy of consideration.

AERATING SCREENS.

To begin with the ovum or egg—air is just as necessary to the well-being and development of the embryo as water. In the running water of streams there is air enough for the necessary aeration or oxygenation of the embryo, but in spring water, as it issues from the ground, there is very little, if any, free air.

In fish hatcheries air is furnished usually by a horizontal aerating screen at the head of the trough, being simply a wooden frame with a bottom of perforated tin or zinc. This is all right in theory, but in practice I have found that the small holes in the sheet of tin, being cut very smoothly, do not permit a flow of water through each and every hole as one might suppose. A film or diaphragm of water is thrown over many or most of the holes, preventing the water from passing through, under the pressure of water usual in most hatcheries. Under these circumstances there may not be sufficient air furnished to the ova or fry, as the case may be. At all events it is well to give them the benefit of the doubt.

After being convinced of the inefficiency of the aerating screen as usually made, I devised one that fully meets all requirements. It is constructed as follows: A piece of soft roofing tin of the desired size is marked with lines an inch apart, both ways of the sheet, and tacked on the frame. Where the lines cross, at right angles, a hole is made with a six-penny wire nail, from the inside of the screen. Thus in a screen of ten by twenty inches, inside measurements, there will be 200 holes. In driving the nail through the tin a shallow dent or depression is made around each hole, while on the under side the hole has a ragged or broken edge.

The simple driving of the nail produces just the conditions that are needed. The water naturally gravitates into the *umbilicated* margins of the holes, and passing through, is broken up by the ragged edges below, imprisoning the air as it falls into the trough. We thus have 200 broken streams of water, the most efficient system of aeration that can be devised, and the most simple. Where the screen is made of the perforated zinc or tin of the shops, the water pours through but a portion of the holes, as before mentioned, and moreover has a tendency to cling to the smooth under surface of the screen bottom, until the water from several holes coalesces, and by its added weight finally drops into the trough in streams of unequal sizes. This condition of affairs is patent to any one who has interest or curiosity enough to examine into it.

I consider the commercial perforated zinc or tin a delusion and a snare for any purpose whatever in fish culture. For foot or guard screens it clogs, for reasons before given, and the smooth round holes are a constant temptation for fry to worm themselves through, whereas by using brass wire cloth the flow of water is free and unobstructed, and fry are not so apt to attempt to pass through it, and would fail to do so if the mesh is small enough.

FEEDING FRY.

I wish to call particular attention to the remarks of Mr. W. T. Thompson on the subject of feeding fry, which may be found in the proceedings of this society for 1900, pages 143-146. I wish to indorse and emphasize what he says concerning the feeding of fry before the yolk-sac is absorbed. I first adopted the plan of feeding grayling fry as soon as hatched several years ago, and afterward trout fry in a similar manner. My plan is to feed the bloody water from finely ground and screened liver, by placing it in the horizontal aerating screen at the head of the hatching trough. While no particle of food may be apparent to the naked eye in the bloody water, it is there, nevertheless, and it is carried along with the water at the bottom of the trough, where the fry soon learn to appropriate a part of it as it floats by them. Coral polyps and other marine invertebrates that are not free swimmers depend entirely for their food on the passing current—food that is not visible to the naked eye, but shown by the microscope to exist in great quantity.

By this early feeding of fry the nourishment contained in the umbilical sac is augmented, and when the sac is absorbed and the alevin becomes a free-swimming animal, it has become accustomed to the liver water, and has acquired a taste for that kind of food. The subsequent surface feeding of liver emulsion then becomes an easy matter. The plan of feeding fry before the absorption of the sac is especially demanded where spring water is used, as it contains no natural food, unless it flows a long distance before entering the hatchery. Where spring water is replaced by stream water as soon as hatching is completed, or where stream water is used entirely, and where, consequently, there exists much natural food in such water, the early feeding of fry is not so imperatively demanded. But if considered in view of the subsequent surface feeding of liver emulsion, which is rendered easier by an early acquired taste for it, as mentioned, it would not be amiss to practice the plan in any case.

DISCUSSION OF DR. HENSHALL'S PAPER.

Mr. Clark: I think that it is now generally understood that all trout breeders commence feeding their trout before the sac is absorbed. They go still further than that, and I think most of the superintendents and those who are distributing trout, deposit them in the streams before the sac is gone. To deposit trout in a stream just after the sac is entirely absorbed, is a case of planting fish in streams to die.

Mr. Titcomb: We formerly planted our fry before the sac is absorbed and before the snow water is out of the stream. We would put them in some times, and I have done so a great many years ago, when our team was carried over the hill on top of four or five feet of snow, on a crust that would sustain horses and everything, and then when we got to the stream, we would slide the tank down on the crust and get to a hole where there was enough current to keep it open and there deposit our fry. I do not believe in that method, although I know that the fry just before the sac is absorbed are more easily transported than just after. I do not believe in planting the fry just after the sac is absorbed. I agree with Mr. Clark on that point. Therefore we keep our fry until they have been fed for six or eight weeks at least, before planting them.

The President: After the sac is gone?

Mr. Titcomb: After the food sac is gone. Then you have got nice strong little fishes, well able to take care of themselves. The streams have then reached their normal conditions also. We begin planting the latter part of May and we plant, you might say, right through the summer. We are shipping all the month of June and into July. There is an intermission through August, and we begin to ship our fingerlings in September and carry shipments right through October, but we cannot in Vermont, with success, plant fry before the sac is absorbed.

Mr. Clark: There is no chance for argument between us. I say that if the trout are to be planted as fry before they are fed at all, they must be planted just before the sac is absorbed. If given any artificial nourishment whatever, the longer the fry are fed the better is their condition for planting. Fry that have been fed only a week or two should not be liberated. Those having taken food two months or more are decidedly superior for planting, the younger fry having failed to acquire in a week or two sufficient growth and strength.

Mr. Titcomb: I think I misunderstood you in the first place.

THE QUALITY OF THE WATER A FACTOR IN REARING TROUT FRY.

BY C. C. WOOD.

In rearing Brook Trout the temperature of the water is usually the first important item to be considered. However the *quality* of the water is also of great moment, and many who have attempted to raise this fish have failed because the above item had not been sufficiently considered, even if given a thought in an intelligent manner.

What is the *quality* of water necessary to successfully rear this fish? A general answer might be, water that is pure and cold; and this in many cases would prove correct.

But in what does the purity of the water consist?

Will analysis determine whether the water is suitable for the purpose or not; were it pronounced pure?

I think that in many instances an analysis will prove little, for while nothing may be detected injurious to the fishes it may be found upon trial that the supply lacks much of the life-giving properties necessary to the health of the fish. Again water of the utmost purity may be entirely unsuited to the trout, while that from a pond or lake, seemingly unfitted almost for common use, if of low temperature, as during the colder months of the year, might furnish a splendid supply for the nursery ponds until warm weather.

In speaking of this subject I would like to consider the difference, which no doubt many of you have noticed, in the quality of the water from springs or streams, starting at no great distance from each other. While on one the trout may be healthy, do well and grow rapidly, perhaps on the other, but a few rods away it will be found impossible to make them live after they have commenced to feed. And yet both waters may be pure and cold.

Let us consider that the water has had sufficient aeration, that the pools are not over-stocked and that the fish are treated the same in each case; what should cause the difference in results?

In one case a splendid success; in the other an utter failure. This is not an easy question for one to answer and I shall not make the attempt. Perhaps some of you present may be able to tell just what the trout require, what *quality* of water is best suited to them.

Many trout breeders, soon after the fry are hatched find it is impossible to retain them in the hatching boxes without great loss, but that if removed to pools out of doors a fair degree of success may be attained on the same water supply. In such cases I should be inclined to think that insufficient aeration was given the water in the first instance, for the mere fact that the troughs and fish were inclosed within a building would hardly cause them to suffer in any way; yet the fact of the water running through the air, and perhaps falling even a few inches from the hatching house to the pools may give the conditions necessary for the absorption of sufficient oxygen to support life in the second instance.

And yet I would not have you think that by the *quality* of the water I mean water containing sufficient oxygen or air only, for there is also something quite necessary besides this I firmly believe, much less understood, too often little appreciated, but of vital importance to the maintenance of the hatchery.

Young trout fry, in my opinion, are very sensitive to sudden changes and a change in the quality of the water, for even a short time, may result in a disastrous loss. If the water has once proven all right the greatest care ought to be taken that it remain so, that no surface water may get into the supply even for a day, that the temperature may not change suddenly by the inflow of melted snow or ice into the reservoir or spring. I believe that nine times out of ten where great losses of young fry have occurred, in a seemingly unaccountable manner, on streams which have been proven suitable for the rearing of this fish, it has been because the *quality* of the water has suddenly changed, which in most cases could have been prevented. If the water has been once proven right take every precaution that it be kept so. Protect your spring or reservoir perfectly. A water supply given all possible aeration by artificial means, may not be changed in quality, at least not in such a way as would be the case were it allowed to run exposed to the air and sun over soil and sand, through weeds and water plants, where it might absorb nature's elixir of life, and perhaps give up some of the elements peculiar to itself when starting at the source.

An instance came to my notice some years ago where the water seemed greatly benefited by the growth of water plants. The trout were confined in a long pool of water coming from driven wells at one end of the pool. It was quite noticeable that the fish did not frequent the upper half or third of the pool, and were much thicker at the outlet than elsewhere. About one-quarter of the pool including the driven wells was screened off and water plants introduced, which grew rapidly, soon completely filling up that portion of the pond. A remarkable change was at once noticed in the behavior of the fish, which were now scattered quite evenly over the enclosure, showing that the water had undergone a change and become suited to their life.

Water from some springs and driven wells however *may* be found of the right quality from the start. I have seen trout living in ponds supplied from driven wells, where the supply came in at the bottom of the pool, and where there was no possible chance of aeration, except what little air might be absorbed at the surface. The water was surely of the right quality at the start for the small fry grew rapidly and were perfectly healthy in every way. At one time I remember (to illustrate the great difference in the quality of the water sometimes found in the same location) that I delivered a quantity of trout fry, late in June to a party in the northern part of Maine. I arrived at the gentleman's place late in the evening, and found that he had arranged a race-way with a suitable screen and that a good supply of water was flowing through from a clear, cold spring a few feet distant. I thought his arrangement perfect and, being rather tired having left the hatchery at daylight, went to my room at once.

Next morning upon inquiring how the fry were getting on I was surprised at being told that soon after being put into the pool they had commenced to die and only quick work saved a portion of them. Noticing that they were acting strangely and turning up, the purchaser who was a practical sort of man, made a temporary place for the fish in a box by knocking out the ends and covering with netting, then transferred the fry to this small box placed in a stream of water not ten rods away, where they fully recovered, and when I saw them next forenoon were as lively and as smart, crowded thickly in their close quarters as they were, as when I started them on their journey the previous day. I doubt very much if an analysis of the waters from the spring and stream would have shown the vital difference in quality, proved beyond question upon trial.

Trout fry may be successfully hatched in water not possessing the quality necessary for future success, and while they may do well if transferred immediately to other streams more adapted to them, such may not be the case if retained under the first conditions until they become sickly and weak. Frequently have I heard someone exclaim: "I don't see what is the matter with my fry, they are feeding well but are dying fearfully!" Such may be the case when the greatest care is taken, the proper methods followed and the eggs from strong, healthy, vigorous, parent fish are used. I should like to mention a case where the hatchery and fittings formed one of the best arranged and complete plants I have ever seen. The water supply was from a spring reservoir with ample aeration. I was asked to visit this plant as the fry were dying in large numbers, and find a remedy for the trouble. As soon as possible I went to the hatchery. The hatch of brook trout that season was nearly 3,000,000, and the sight I saw on arrival made me shiver. The fish, just on the point of feeding, were dying by hundreds of thousands daily, and the bottom of the troughs were covered with dead although the man in charge assured me that all dead had been removed the day before. A most careful search failed to show anything wrong, the water was cold and splendid to drink, and all right for "it had been analyzed." Yet nevertheless I told the man that I did not believe trout fry would live in that water for the quality was not right for them. He replied that it must be for there was trout living the year round a quarter of a mile below, in the same stream. But future seasons proved that I was correct, no trout fry could be reared in that water and after a time the attempt to do so was abandoned. The methods followed were right—the quality of the water alone prevented a gratifying success.

I might mention several other cases of the almost total loss of fry at hatcheries supplied with water of poor quality for this purpose, but I can suggest no way of proving the quality except by trial. Most likely if wild trout are known to inhabit certain waters during the year the conditions are suitable for their maintenance, and this should go a long way toward deciding on a suitable location for a hatchery. But one will see that although trout may be found in a stream during most months of the year, and living in a perfectly healthy condition, it does not follow that they were hatched in that particular water. It may be that somewhere the length of the brook a spring or tributary makes in where the spawn was given out by the parent trout, and while this smaller creek is of just the right quality for the young troutlet during the first few months of his life, perhaps the stream in which the larger trout was observed would prove very unsuitable. I think that it might be perfectly safe to say that where trout fry will live mature trout will live also, but many a failure will be made trying to rear fry where the larger fish will do fairly well. And lots of nice trout fry are wasted yearly by being planted in unsuitable places, where fingerlings or yearlings would live and grow. And almost everyone admits this, and still the same thing is done again and again.

Speaking of the planting of trout fry and fingerlings, I have never yet met anyone who advocated the planting of trout fry exclusively who was successful in rearing them much past the sac period. However, better to hatch a few million fry and scatter them broadcast into our waters than to do nothing; better still to raise some fry, some fingerlings, and plant them in an intelligent manner. And why cannot this be done? It can and should be done in every state having natural waters for this fish, for springs of the *right quality can be found* where the fish could be reared easily, for almost with neglect will they thrive and grow in waters just suited to the purpose. I feel that the idea I have tried to present should be nothing new to most of you present, but if generally thought of I would like to ask why it is that so many of our public hatcheries are maintained year after year on a water supply that makes success of rearing the fish impossible. True they may be hatched and planted when a few weeks old, but how much better to rear a portion of them for as many months, how much more gratifying to grow some of them to the yearling age, for the mere hatching of millions of trout and retaining them during the yolk sac period only, is a small achievement compared with the raising of one-tenth of the number to a year old.

DISCUSSION OF MR. WOOD'S PAPER.

Mr. Titcomb: I wish to bring up one subject in connection with the paper for the consideration of the members, with the possibility that if it does not bring out discussion here, it may develop something in the form of a paper another year.

I have been experimenting with the eggs of the domesticated trout and the eggs of the wild trout. The eggs of the domestic trout are kept in spring water at these commercial hatcheries at a temperature of about 46 degrees, and the parent fish are kept in what you might call spring water in those drive-well hatcheries. In taking them to my hatchery and subjecting them to a temperature during the winter sometimes as low as 34 degrees, yes, even down to less than 33 degrees, (you can see the frost sparkling in the water) the eggs of the domesticated fish seem to be affected, while the eggs of the wild fish do not. Now I do not consider a water supply for a hatchery good which goes down to that extreme low temperature, but the question arises in my mind whether the domesticated trout reared in spring water will produce an egg which can be hatched as well in the cold water as the egg of the wild fish which is subjected to all temperatures of cold water, you might say. There is a point there that I have not been able to settle in my own mind, but I have suspected that trout which have been kept for a long time, or in different generations, in the warmer water throughout the winter, are not so well able to exist in the lower temperatures as the wild trout.

Mr. Clark: I take it from Mr. Wood's paper that it turns more upon the kind and quality of water. Of course, as you are aware, I have had considerable experience in trout culture and fish hatching for quite a number of years. Now I just want to give you my ideal of water for a hatchery: It is to have two kinds of water, as we have spring water, and either creek or lake water. In having the two, which range during the hatching season from 32 1-2 to 46 or 48 degrees, we are enabled by mixing the water to control and regulate the temperature, determining to a great extent the period of incubation—especially with our lake trout—turning out the fry at such intervals as are convenient for distribution. In other words, fry from eggs of the same age do not all hatch at the same time, some being retarded by colder water. At Northville we can distribute fry for two months—holding them right in the hatchery—and never plant any with the umbilical sac completely absorbed.

Mr. Bower: I have been personally acquainted with Mr. Wood for some time and I believe he is one of the most intelligent and successful brook trout breeders in the country today, but I cannot agree with his conclusions as to the relative merits of planting fry and fingerlings. He rather intimates that the planting of fry is not very successful. I think there is no example in the whole United States of more successful trout planting than is presented in the state of Michigan. Over two-thirds of the trout streams in the state today, comprising some of the very best trout waters to be found anywhere, did not contain trout naturally, and their present standing as trout waters is due wholly to the planting of fry and not fingerlings. Now, I believe that if you plant a thousand yearlings or a thousand fingerlings you will get more adults than if you plant a thousand fry, but the point is right here: a thousand dollars' worth of fry, in my judgment, will produce a much greater number of adult fish than a thousand dollars' worth of fingerlings or yearlings, because there is some loss in rearing and there is also a heavy expense for food and care, and it costs twenty dollars to distribute a given number of yearlings to one dollar for an equal number of fry, so that you can plant such a vastly increased number of fry for the same amount of money that you will get much greater results for the money invested, presuming of course that the fry are properly planted, and that you must assume also with yearlings or fish of any age. So that, so far as the state of Michigan is concerned, we are thoroughly satisfied with fry planting and propose to continue it—it is no theory with us, we have the results to show what the planting of fry will do.

Mr. Clark: I see that Mr. Bower since he went with the Michigan Fish Commission, has become a great fry man. I have had arguments with some of the members of the Michigan

Fish Commission in regard to the fry and yearling matter and am on record in that respect. Neither at this time nor at any future time do I wish to take up the argument again, and especially with Mr. Bower. When Mr. Bower was with me he was one of the most rabid yearling men you ever saw, but I think Mr. Bower is all right, and he does believe in raising or partially rearing fish for planting, but not of course if you undertake to raise three or four million—that you can not do. But raise what you can, one hundred thousand, two hundred thousand or something of that kind, and I do believe that if you ever get lake trout established in many of the lakes in the state of Michigan you must rear them before you get them started. A brook trout two to four inches long is just as well able to take care of itself in the wild waters as when it is a year old, as everybody knows.

Mr. Bower: I just want to correct one impression. Mr. Clark says that when I was with the United States Fish Commission I was a rabid yearling man. Well, when I first commenced to hatch fish I was with Mr. Clark, and naturally drew my inspiration on fish matters from him and accepted his views and ideas as authority. But by and by when I began to read a little and learn a little by observation, and began to do a little thinking on my own account instead of allowing him to do my thinking for me, I began to modify my views, and long before I left the employ of the United States Commission, I was forced to admit that the planting of trout fry in Michigan streams produced excellent results. I was confronted with "a condition and not a theory." And I think Mr. Clark has changed his attitude very much, for he says when you want to plant three or four million fry it is all right, and that is exactly the point I would make. I say it is not true economy to undertake to raise five or ten million trout for planting, and that it is neither necessary or advisable, for your money will go a great deal further and the ultimate results will be much greater if the total cost of production and distribution is applied to fry instead of yearlings. This may not be universally true or true under all conditions and circumstances, but I am speaking of trout planting as it has come under my immediate observation. I really think Mr Clark has come over to my way of thinking to a great extent himself.

Mr. Clark: There is not a single place in all the transactions of the American Fisheries Society, or in any of the reports ever given by me to the United States Fish Commission, where I have ever written or said anything advocating the rearing of all the fish that are hatched—never.

The President: To fingerlings?

Mr. Clark: No, sir.

DISCUSSION ON CARP.

LED BY DR. S. P. BARTLETT.

Dr. Bartlett: From a practical standpoint I want to say to you that the United States Fish Commission builded a great deal wiser than it knew when it introduced carp in the waters of Illinois. I am here as representative of the United States Fish Commission, and I want to say to you that the waters of Illinois have proven more acceptable to carp than many of the other waters. I want to speak of that of which I know. The work of the Fish Commission depends entirely of course upon the money they have to run their business. It is getting to be practically a matter of dollars and cents, this Fish Commission business, and ought to be in the various states, but that is particularly true in Illinois. There is, perhaps, no one here that has been a stronger advocate in years gone by of protection than myself. I early made up my mind that any law the enforcement of which would kill a fisherman was next to gospel. I have changed my mind as to that considerably and believe now in propagation rather than protection. The last legislature of Illinois enacted laws which prohibit the taking of black bass, wall-eyed pike, etc., except with hook and line during the whole season. The carp on the other hand have been subject to a little more of the open season and are permitted to be caught more months in the year. I want to say to you briefly, however, and without giving you any reasons for it, because you all know what my reasons are, that the carp have produced in the State of Illinois more money than all other fish put together. That seems like a pretty hard statement to make, but it can be verified, and I want to say to you that there are more carp eaten on the hotel tables in the State of Illinois than any other fish. I have been served with "red snapper" which turned out to be carp. This cry against the carp is a great big humbug—it is an outrage—they are a good fish if you know how to cook them, but not so good if you don't know how. Most of you are men of leisure and like your black bass and whitefish, but what about the one dollar and ten cent a day man? He has got to take carp. Illinois produced three quarters of a million of dollars in coarse fish last year. It would be as much as your life is worth to take a trip down to the Illinois river and tell the men there that carp is not a good thing. They would take you out and duck you gracefully into the river. More than one-half the towns on the Illinois river depend mostly for their existence on the fish industry, and considerably over two-thirds of the fish taken are carp. They grow anywhere and everywhere; they grow with the black bass, and the black bass are as plentiful as ever. Illinois can furnish one-half the black bass for stock in the United States, and yet there will be no diminution in quantity. We take just as many black bass with the hook and line this year as ever, while the carp are steadily on the increase. I have no patience with the newspaper talk that says that the carp are an enemy of the game fish. I do not believe anybody can prove it. I would like to hear it if it is so.

The carp in this state are accused of eating up all of the water plants,—in fact they have been accused of destroying the duck hunting in the states of Illinois and Indiana; they have been accused of almost every crime that fish can be accused of, but I do not believe any one can prove that the carp has ever been an enemy of the game fish or destroys its young or spawn. That is a pretty bold statement to make, but we have representatives here from all over the country, and I would like to hear what they have have got to say on the subject. I hold the position that the United States government made the most practical plant of any of its plants when it planted carp in the muddy waters of such states as Illinois and Indiana. Twenty-five years of experience with people in the state of Illinois in the fish business has been up-hill work. I took the commission there when there was not a line on the statute books for the protection of fish, and I have followed it up until now, and previous to the introduction of the carp the muddy waters of Illinois were almost depleted of coarse fish, and today it is shipping to the east more and better fish than any other western state.

If I get a little bit extravagant, please attribute it to old age and forgetfulness. I do not wish to make any mistake or to exaggerate. I came here just to provoke the discussion on the carp.

Mr. Peabody: I am very glad that Dr. Bartlett, the friend of the carp, has introduced the subject, because we want to get some information in that line. I have run up against a number of very strong statements regarding the injury that carp do the fishing and shooting interests of Wisconsin. Only a day before this meeting began I attended a meeting of the directors of the Diana Shooting Club, and some of the directors stated emphatically that the carp were ruining our shooting, that they were eating up the wild rice and wild celery. One of the gentlemen said that the introduction of carp in Lake Koshkonong had destroyed the fishing of black bass and pike; that they roiled the waters and kept them in that state all the time, and that therefore the black bass and pike were driven out and did not propagate. I was in hopes that Mr. Ravenel would be here, because he has been the one defender of the carp at all these meetings, and I have always relied on him as to the value of the carp. He stated last year that the highest priced fish sold in New York during November and December was carp; that they came in with the turkey and were considered edible and valuable. Now some of the fish culturists here undoubtedly can give information that will be of value to us in this state especially as to just how much injury carp are and do, and if there are any gentlemen here who can answer the question, do they destroy the wild celery and the wild rice on such marshy ponds as are frequented by ducks, to the injury of the duck shooting, and do they roil the water so as to prevent the propagation of such game fish as bass and pike, and do they destroy the spawn, and do they go on the spawning beds of the black bass and destroy them, the information they give us will be very acceptable. Those are questions that I wish might be opened up here and discussed freely so that those of us who are not thoroughly posted on the subject may become so.

Mr. Townsend: It may be that the carp has been introduced in some places where it was not needed, where other kinds of fish were more important; it might not be advantageous to introduce the carp into the beautiful little lakes of Mr. Peabody's state; but there are many waters in this country teeming with carp, and people are finding out in many places that carp is a food fish. There is a market for carp in the big eastern cities and carp will sell there. They sometimes sell even for a high price; generally they sell for a low price and are bought by poor people. There are many foreigners in our eastern cities that are steady consumers of carp, and take all that come to market. Carp go to market generally in good shape; they can be packed in ice in Illinois and will reach New York alive. If they are properly cooked they are very good fish.

Now we have in our waters a pretty good supply of coarse fishes. There is a tendency on the part of legislatures to cut off the commercial fisheries, to reserve more and more waters for hook and line fishing. This harvest of coarse fishes still remains. If the crop is not harvested it is lost. In the Illinois river they catch over 14,000,000 pounds of fish a year, chiefly carp and buffalo. That affords employment to 1,000 fishermen, who incidentally catch other fishes. It can be shown by statistics in the Fish Commission office that the yield of black bass in this great carp river, the Illinois river, has increased along with the carp. They now catch more bass than ever and the chances are that the young carp are food for the bass and the more predatory fishes.

The work of the net and seine fishermen in the Illinois river results in the capture of these coarse fishes, carp, buffalo, cat fish and dog fish, and the other fishes taken do not count for much. At the same time there are plenty of game fishes for those who want them for sport—such fishing is better than ever. So there are undoubtedly many waters in this country that will support the coarse food fishes and the fine game fishes without the one being an injury to the other. That may also be the case in Lake Erie where the carp catch is already important and marketable.

The dealers of Sandusky and Port Clinton are shipping all the carp they can get, not only to the eastern markets but to St. Louis, Cincinnati and Louisville.

On the Pacific coast the carp is abused just as much as it is elsewhere, and yet the Chinese of California are consuming carp and cat fish more than any other kind of fishes.

In New Jersey the carp have taken to living in the slightly brackish water, and most of the catch comes from those waters which lie between the more salty bay waters and the fresh waters. The carp there are in places where they appear to hurt nothing, and they are beginning to find their way to market. If I had a big lake I should not hesitate to stock it with carp, and I should expect it to pay before very long.

I could go on talking about carp indefinitely. I do not know how much they roil the waters and how much they interfere with the feeding of wild ducks, but perhaps some of the other members do.

Mr. Clark: Mr. Townsend said that he did not think that the fishermen were yet catching many carp in Lake Erie, but last year in Maumee Bay, according to reports, carp were being caught by the ton, and I understand from Mr. J. N. Dewey that they are establishing there a system of keeping the carp when the market is low and putting them on the New York and Philadelphia markets when prices are high, also that they are making ponds along Maumee Bay and they catch the carp and hold them in the ponds until they wish to send them to market.

Mr. Townsend: It should be 3,000,000 pounds for Lake Erie—the figures were put too low.

Mr. Clark: I understand they do not catch so very many carp down in the lake along the islands, but the carp are there. In Detroit river during the last two years but few carp were caught, but it is possible that the carp will remain in great numbers in Lake Erie and will stay in such places as Maumee and Sandusky bays.

Dr. Parker: How is it up about the Flats?

Mr. Clark: They have some. There is some kicking about the carp.

The President: I can tell you about the Flats. I go up on the boat to the Flats twice a week, and every time I come down on the boat I get a damning from some bass fisher that claims the carp are destroying the bass fishing. But notwithstanding their claims the bass fishing on St. Clair Flats has been better during the last three years than at any time during fifteen years previous, and we have not planted any bass either. I can not account for it in any other way except that the environments of the carp and black bass are absolutely different. Black bass likes a clean, pure, sandy bottom, and the carp lives on a muddy, weedy bottom. I believe that the carp is a good thing in many waters where black bass thrive. I believe that the bass fishing at the

Flats has increased by reason of the food that young carp make for the bass, though he was not planted there. Millions of them are up there and you will see their backs sticking up out of the bullrushes. The only injurious thing that I believe they do is to destroy the food for the perch. Our perch fishing is not what it used to be, and the carp living up among the weeds and rushes cleans out the weeds at the bottom so that there is not as much vegetation there for food for the perch as there otherwise would be; so it is my judgment that the carp has injured our perch fishing but improved our bass fishing.

Mr. Titcomb: We all know that Mr. Bartlett is an authority on the carp; we also have here an authority on the bass. The question which I was going to ask and which Mr. Peabody did ask, was whether carp destroyed the spawn of bass. I say no, but I am not an authority. Now in Buffalo there is a strong fish and game association which obtained permission of the New York Fish Commission to seine the carp out of the river for the alleged reason that they destroyed the spawn of the bass, and when I passed through there they asked me to bring that question up at this meeting. Now, I should like to hear from Mr. Bartlett in answer to those questions which Mr. Peabody fired out so rapidly, he answering them as direct questions and as an authority, and I should like the views of others who have had experience with either the carp or bass, on that question, so that we can have a direct record on our minutes of these questions which have been asked directly and answered directly, in addition to the valuable information which we have been getting through the remarks of Mr. Townsend and yourself.

The President: Do the carp destroy the spawn of black bass?

Dr. Bartlett: You are placing upon my shoulders rather more honor than belongs to me. I am not an authority on the carp further than an intimate association with them during a number of years has given me the privilege of a good deal of observation.

Our Illinois river is really a series of lakes from one end to the other. The river itself is anywhere from seven to fifteen miles wide, and there is a considerable chain of lakes or low places on either side of the river, extending the whole length of the river, and making an immense body of sluggish water. Interspersed are a large number of spring lakes. In order that I might know positively what amount of injury had been done by the introduction of the carp into the waters of the Illinois, I took occasion when carp were first brought upon the market and the hue and cry raised as to their destructive qualities, to open and be present while hundreds of carps were opened, to see if I could find in their stomachs anything that would indicate that they took the fry of other fish or spawn of other fish. I can not say that I have never found the spawn of other fish in their stomachs, but when I have found such spawn it has been of such a nature as led me to believe that it was such spawn as floated on the surface of the water, and that the carp took them in, in that sucking motion that he has, going around on the surface of the water.

So far as their eating up the growth in the water and destroying that is concerned, that is to some extent true, but I do not think that it is extensive enough to drive away the black bass from their breeding grounds or in any way interfere with them; and I think, Mr. President, you struck the key note exactly when you spoke of the increase of bass being due very largely to the immense supply of young fish for food. My work on the Illinois river is of a very peculiar nature, and I say this to show you why I gave you the figures that I did. Our work is simply saving these fish out of the overflow. There are thousands of acres of land planted to corn today where the land was water a few months ago, and thousands and thousands of acres more will dry up before the season is over. Into those places we go and take out the young fish, and a very careful estimate made after years of investigation, shows that not over fifteen per cent. of fine fish are taken out of those places under natural conditions. That is, go into a place that is not disturbed and eighty-five per cent. of the fish will be the coarser varieties and fifteen per cent. perhaps of the gamey varieties of fish, and not over one per cent of black bass. When we take into consideration the fact that is so well known of the voracious habits of the black bass, it shows an all-wise provision of nature to supply a very large quantity of coarse fish to feed the other fishes, and I believe as firmly as I am standing here that if the carp had not been introduced in the state of Illinois, the buffalo having become almost extinct in our waters although it was once the great commercial fish that the bass would have been gradually taken out entirely from the list. As it is now, I want to repeat the statement that we have more black bass than ever, and our carp certainly have increased in a greater ratio than ever before.

Mr. Townsend: The figures prove that you have more black bass than you ever had.

Dr. Bartlett: Yes, sir. In our work for the United States Fish Commission we took this year from Barlow Lake, which would cover perhaps a mile in length and five hundred feet to a quarter of a mile in width, low and shallow, 51,000 black bass for distribution. Now that is in a mud hole, and there is no estimate as to the amount of carp that were removed at the same time and put into the rivers—they have been simply beyond computation.

As I said before, I have worked faithfully for carp all these years. For the first few years, fishermen would take the carp, open them up and dress them for sale the same as buffalo, and I had free access to the stomachs of the carp and failed to find to any considerable extent evidences that the carp has interfered with the spawn of other fishes. That is true at least for the muddy waters of Illinois that abound with plenty of other food for the carp. What might be the result in some of your cold water lakes in Wisconsin I can not say. The carp have a very peculiar value in that it is not necessary to dress them for shipment. The buffalo fish you might ice down as carefully as possible and within a very few hours he becomes soft, and therefore you have to dress the fish before shipment, and I believe about two-fifths is allowed for dressing. But the carp is shipped so to speak, with guts, feathers and all; he is taken right out of the water, covered with ice and frequently shows signs of life after being in a refrigerator car forty-eight to sixty hours, and every pound that is taken from the water by the fisherman is utilized to bring back so much per pound from the market.

It is only justice, however, to state that these carp are used in the east by a class of people who will not eat anything unless it is pretty nearly alive—Russian Jews, Poles, etc.

If there is any direct question that I can answer from personal observation I shall be very glad to do it.

Mr. Peabody: What do you know about the roiling of the water?

Dr. Bartlett: At certain seasons of the year they do make the water very roily. But we are to consider that our black bass are taken from waters that frequently have six or seven inches of mud at the bottom, and so it makes no difference.

Mr. Peabody: You do not think that that is important?

Dr. Bartlett: Yes, sir. There are a great many places in Illinois where the introduction of carp has proved a disadvantage. I know that to be a fact, in small spring lakes, take a lake of four or five acres, something of that kind.

Mr. Peabody: You would not think that a lake of one to three miles in size would be affected at all?

Dr. Bartlett: No, sir. My observation has been that the very best fly-fishing in the United States can be had upon the Illinois river today.

Mr. Titcomb: Is it not a base slander upon the bass to intimate that it would allow a carp to touch its spawn?

Dr. Bartlett: I should think so.

Mr. Bower: I think that where bass and carp inhabit the same water it is natural that the bass should increase. We have been hatching black bass for a number of seasons in ponds where we have an opportunity to observe their spawning operations from the time the male fish begins to prepare the bed until a good many days after the hatching is completed, and we know that the male bass guards the bed against all intruders. He will put up the stiffest kind of a fight against any animal that approaches the bed with a view of preying upon the spawn. There is no danger of a carp ever looting the spawn from a black bass bed. On the other hand I do not think the carp can retaliate against the bass in any way, shape or form. While the bass is preying on the carp, the carp can not come back at them in any way. In other words, in the interchange of hostilities between the two species, the bass gets the better of it at every stage of the proceedings, and I think it is a perfectly natural result that the bass should increase in waters where there is an abundance of carp.

Mr. Peabody: I would like to have Mr. Lydell's opinion on this subject.

Mr. Lydell: I never have known but a single instance where the carp has destroyed the spawn of the black bass, and I never knew of their destroying any other spawn. I have handled and opened what few carp were caught at the Detroit river, Belle Isle, Fisheries, during the last ten years, but never found any spawn in them.

Every one here seems to be friendly toward the carp, but a gentleman a while ago said he did not know how to cook them. I think it would be a good idea for this society to educate the people how to cook these carp. The only experience I have ever had in cooking carp I got from a German friend of mine at Mill Creek. He was a saloon keeper and had been at me for a number of years to get him some carp. Last spring I procured him two that weighed about four pounds apiece. They were cooked by his wife and I was invited down to dinner. I enjoyed the carp very much and I asked him how he cooked them. He said they were stuffed with sauer kraut and boiled in beer. (Great laughter).

Mr. Townsend: Just another point in this connection that may save discussion: We hear a great deal from sportsmen's clubs and from other sources as to how the carp can be exterminated. It can not be exterminated. It is like the English sparrow, it is here to stay. At a meeting of the American Ornithologists' Union a while ago, one of our foremost ornithologists stated that the European sparrow could not be exterminated in this country. I think it is the same with the carp. It is here to stay and we can not exterminate it any more than we can exterminate the green grass of the fields. I do not wish to pose as an advocate of the carp—I prefer other fish for myself—but I maintain that the carp has a place in good and regular standing in our big eastern markets, and I do not think that our great republic with its rapidly increasing population can afford to sneer at even so cheap a source of food.

Dr. Parker: I wish to say just a little bit in regard to this matter. The carp is the most omnivorous of all fishes. He is a hog and will eat everything. He will eat spawn if he gets it, but I do not think he will search it out. I believe, as the president here has said, that the black bass will increase as a result of the presence of the carp, but we will see a depletion of the perch. As I said in my paper, you must go back to the vegetable for the rehabilitation of waters. If you destroy vegetation and the larvae, you destroy the minnows, and the perch have no minnows to feed on, unless they can eat the young of the carp, which they do not appear to do, but the black bass will eat the young of the carp and will thrive. Therefore you may look for an increase of the black bass, a decrease of the minnows, and also of those fish that feed upon the smaller minnows. I shall look for that in the balance of life that would naturally occur in a stream like the one described. That the carp do make the water roily goes without question. The old German (Hessel) who brought the first carp to this country told me in Washington that a clear carp pond would be an anomaly. They stir up the mud at the bottom of the stream, and live on the larval and vegetable life they find there. I believe then that the black bass will certainly increase with the carp unless the carp gets so numerous as to feed on the bass beds. Of course with a carp weighing twelve or fifteen pounds, an ordinary black bass weighing four or five pounds will not have much show.

Mr. Clark: Yes, he would.

Dr. Parker: He might whack away at him—they are not a very scary fish. I think that the carp has got more brains in his head than any other fish that swims. When I was on the commission over at Glenwood where they had the beds I tried time and again watching the carp that would be feeding on the edge of the pond there, by starting the slash-board, and every one of them would put right for the center of the stream, knowing at once where they were safe. I experimented a good deal with them and they are certainly the most wily fish I ever met.

Mr. Titcomb: I just want to make a statement about the bass, because this talk will be read not only with interest by absent members, but by sportsmen everywhere. The doctor intimated that a bass would not keep a twelve or fifteen pound carp off from the spawning bed. I want to make the statement, and if I am not correct I want to be corrected here, that the bass uses his dorsal fin as a weapon of attack and defense, and when a two or three pound bass runs his dorsal fin against a fifteen or twenty pound carp, Mr. Carp will move off, if he is not dead.

General Bryant: I wish to make a friend of some of these friends of the carp, and get them to tell me their methods of catching, shipping and cooking him, and I would suggest that a paper be prepared next year upon that subject. The greatest trouble we have in some of our lakes in Wisconsin is that the carp have got in there. I do not know of a fisherman in Wisconsin that would catch one if he could, and I never heard of one being eaten either by anybody in the circle of my acquaintance. They were originally put into the muddy ponds, but in the high water they washed into the streams and have found their way into our lakes and are there by millions. They occupy the shallow sedge and muddy bottomed portions of the lakes, and I have often wished that somebody that knew how would start a method of catching them and shipping them, because I have heard so much said about it, and I always believe what the Illinois people say about the carp, and I do not question their veracity or their judgment at all, but the people in our section of the country are not educated up to the idea of appreciating the gospel according to St. Bartlett (applause and laughter) and other disciples and brethren of that faith. I am not questioning the truth of the gospel, but I am lamenting that it is not spread in our section. Within a radius of five miles of Madison there are billions of carp. Every fisherman sees them, curses them, and refuses to catch them. They seem to thrive there in the clear Wisconsin lake waters. There are many springs in part of these lakes, there are bars where the bass hatch and propagate and little sedgy inlets, indentations, bays, and sloughs, or whatever you may call them, where the sedge grows and vegetation springs up through the water, and there the carp are to be found in vast multitudes. Of course they can not be seined out from that kind of water. Now, what is the best way to catch them under such conditions in large enough quantities to ship? When you get them, what is the best way of cooking them? You tell us they are served in the restaurants in New York as a luxury, how can they be made so? If you can convince our brewers that to boil them in beer is the true way to prepare them, we will certainly have a strong auxiliary right hand to help us. (Applause).

Dr. Bartlett: While I am a strong advocate of the carp and their increase and value and all of that, yet a note of warning ought to be sounded in every state of the union as to legislation on the subject of the carp, and it should be of such a nature as to keep them down. If the people of the state of Illinois had had their way two years ago, the Illinois river and all the waters of the state would have been so full of carp as to have crowded out all of the other gamier varieties of fish. Carp increases so rapidly that legislation in all states ought to be had to allow them to take these coarse fish. We have thrown open the state of Illinois to the seining of these coarser fish.

To answer my friend's query as to cooking them, permit me to say that a carp taken out of the very muddiest of water, killed and bled as soon as taken out, laid in salt water over night, parboiled and baked with proper sauce, can not be distinguished from the finest red snapper.

Dr. Parker: Another mode of preparation of carp is by smoking and curing them, as is done with halibut and sturgeon. A gentleman who had eaten them said to me he liked them better than halibut, though not quite so well as sturgeon, which he considered the finest smoked fish in the world.

Mr. Dunlap: In the line of General Bryant's suggestion I would like to move that Dr. Bartlett be requested to prepare a paper on the subject of carp, covering the subject as fully as possible, to be read at the meeting of the society a year from now, and I would say that the fish commission would be very glad to publish that paper in the Bulletin, as we all know there is very little literature on that subject; and I think from what we have heard that Dr. Bartlett is prepared to discuss the subject in all its phases.

(An inquiry was made as to the value of the carp as a game fish, that is as to their being any sport in getting him with hook and line).

The President: Yes. If you can get him, it is great sport. But the only way to do it is to take a piece of potato or dough and sink it to the bottom, and when you have got him on your hook there is no fish in the world equal to him for sport.

Dr. Parker: A kernel of corn will do very well for bait.

Dr. Bartlett: A man who has been many years in my employ tells me that the best bait for a carp is a dough ball incorporated with cotton to make it firm, and that a potato fried, but not too crisply, is the next best bait. I have seen three hundred and fifty people fishing at one time for carp with hook and line. These fish make a big fight because you cannot drown them.

Mr. Townsend: I brought with me a bundle of statistical sheets of the Mississippi region and the Great Lakes region, and if any members want them, they can have them.

Mr. Titcomb: I wish to suggest some topics for consideration at our next meeting. We get our calls for these meetings a short time beforehand and are busy and do not think just what we want to talk about. Now, on a recent trip I met a friend who joined the society at this meeting, Mr. Parker of the province of Quebec, and we traveled over thirty lakes in a canoe and caught trout in every one of them. One of those lakes was eight miles long and just teeming with trout. There seemed to be an abundance of food and the conditions were just the same as in the other lakes, and yet none of those trout that we caught there would weigh over one-third of a pound, and the average would be about a fourth of a pound. The next lake might give you trout which would average a pound, some of them going as high as four pounds. Passing on to another lake you would get trout the average of which as taken with the fly would be half a pound, and another lake three-quarters. You could pass on to the last lake and pick up trout at every cast in six to ten inches of water with the waves a foot high so that the fish would jump right out of the water and land on the sand if they did not happen to catch your fly, and the fish would run about three to a pound. Now the question which I have raised and put in the form of a topic is given here this way:

"Given the same kind of water, food, etc., the same environment so far as appears from a superficial examination, why such a great variation in the growth and average size of adult trout in various lakes?"

There is one other question which comes up very often and which I think has never been answered and I would like to see a paper on it if anyone has an opportunity to study into the subject, namely:

"The cause for variation in color of flesh of speckled trout from any given body of water."

Of course the general variation relates to different bodies of water, but frequently you can take fish right out of the same pool, or without moving your boat from a certain spot, which have a distinctly white meat, a light pink meat, and a rich salmon colored flesh. The general answer ordinarily given to that question is "food and environment," but it does not answer the question when you can take those fish with three colors of flesh out of a space ten feet in diameter.

Mr. Peabody: Mr. Lydell is a specialist in bass culture and I have had the question asked me and the statement made boldly that the large mouthed bass cast their spawn in the weeds and against the weeds, and do not make a bed like the small mouthed bass; and if that question can be answered authoritatively, I think it would be a source of satisfaction to a great many who are interested in bass culture and in bass fishing.

Mr. Lydell: This last season our big mouth bass spawned on several different kinds of beds, but in no instance have I known them to spawn without first cleaning away the vegetation and getting to the roots oɪ the weeds. Some of their eggs were found on the weeds adjoining the beds cleaned off. This year they also spawned on prepared gravel beds, and on other artificial beds having various materials on the surface and imbedded in the cement mixture of which the beds were made, such as Spanish moss, cocoanut shreds, sea grass and excelsior.

The President: But where is the natural spawning bed of the wild big-mouthed bass?

Mr. Lydell: It seems to be on roots of the different weeds that grow in the lakes around the shores. The bass there also spawned on roots and bark that were in the bottom of the pond, and also on lily roots in the pond that is prepared at that station for large-mouthed bass. This pond had been set out to pond lilies, and they cleaned the roots off under the lilies and spawned on them. So I say I think the large-mouthed bass will spawn on most anything, but they prefer the grass roots.

The President: That is the natural spawning bed of the wild bass.

Mr. Lydell: Yes. In one pond that we have, almost invariably they have cleaned off the dirt from the roots carefully around the shore, and spawned, but in the pond that I mentioned where they were confined they did not have enough room to spawn on those places, and so they cleaned off the roots, etc., as I have mentioned.

Mr. Peabody: In your opinion will the large-mouthed bass guard their spawn beds as pertinaciously as the small-mouthed bass do?

Mr. Lydell: I do not think so. I do not think they are as voracious or as great fighters as the small-mouthed variety. I think they will give up easier and let something else destroy their bed easier than the small-mouthed bass. The question was raised here a few minutes ago regarding the fighting qualities of the small-mouthed bass. I know of one small-mouthed bass that guarded its bed until it died right on the bed fighting ten other small-mouthed bass, and some of them a great deal larger than he was, but he kept them off for a day and one night until they killed him.

The President: I have made this assertion, that no carp ever got hold of an egg of a black bass unless Mr. Bass had been first taken off from that spawning bed. I do not believe there is such a thing as a carp ever having devoured a single egg from a black bass bed where the black bass was on the bed. Of course if the beds are deserted that is different, but as long as the bass is alive and guarding the bed, no carp ever got a single egg.

Dr. Parker: My observation regarding the spawning habits of the large-mouthed bass is that in the natural state they prefer the lily roots, but in their absence they will take the roots of grass or anything, but they like the large spread of the lily root.

Mr. Bower: Mr. Ravenel stated at the last meeting that in the southern states the big-mouthed bass spawned on sand, gravel, clay and in fact almost everywhere, but that they preferred lily roots.

Dr. Bartlett: The state of Illinois presents exactly that feature in the spawning of bass—you will find their nests everywhere from gravel to simple mud. Fifty-one thousand small black bass were taken from a place in a pond where there is no gravel, but a black loam mud running from twelve to twenty inches deep.

Mr. Peabody: Is it your conviction that the large-mouthed bass do not protect their spawn or young?

Mr. Lydell: I say they do, unless a large number of other fish drive them away. They will give up easier than the small-mouthed bass, but they will stay with their fry longer than the small-mouthed bass. I have had them guarding their fry until they were one and a quarter inches long, and unless the water becomes very roily they will not desert their fry, but if it does become roily they will.

Mr. Nevin: I saw hundreds of them spawn this year and not one of them protected their spawn at all. The large-mouthed bass do not protect their young but the small-mouthed bass will.

Mr. Lydell: We had some large-mouthed bass that spawned and deserted their spawn in a couple of days, but on examination we found that the eggs were blasted, and the bass undoubtedly knew that.

Mr. Nevin: What percentage of eggs do you find impregnated among bass?

Mr. Lydell: I think close to ninety-five per cent., when they do fertilize, is fertilized, among large-mouthed bass.

Mr. Nevin: How much among the small-mouthed bass?

Mr. Lydell: The small-mouthed bass, some of them nearly 100 per cent., and I have had them fertilize as low as ten per cent.

Mr. Nevin: With our beds this spring they did not impregnate forty per cent.

Mr. Lydell: I have had that same condition.

Mr. Bower: I think it was stated at the last meeting that carp brought ten to twelve cents a pound. I would like some further information on that point.

Mr. Peabody: The statement has been made that during the season carp has brought twenty-five cents per pound.

Mr. Bower: On Lake Erie in the month of June they get down as low as $10 a ton. That is all the fishermen get out of them. I have clippings here that show that statement to be true. They have hard work to find a market for them at $10 a ton. Is that state of things due to the fact that it is the wrong season, or are the Illinois fish of a better quality.

Dr. Bartlett: The carp do not bring the prices I have given at all seasons of the year, but along the Illinois river they undertake to catch the carp and hold them until the best season to sell them, and they are placed in ponds for that purpose. On Clear lake on the Illinois river a man has an enclosure of ten to twelve acres, and these fisn are put in a pen as it were and kept until the proper time to market them.

Mr. Clark: As I have casually looked over the market reports in the Fishing Gazette, I do not think I ever saw carp quoted above three cents. I have looked at the market reports on whitefish, bass and everything else, and if I recollect rightly, from two to three cents is the quotation on carp.

Dr. Bartlett: I can show you quotations at six and seven cents.

Mr. S. W. Downing, Put-in-Bay, O.: The reports show the price at Ft. Clinton to be forty to sixty cents a cwt. One firm informed me that the day before I was there they had bought and shipped 28 tons of carp. The same firm last year bought and shipped 700 tons, and another firm there I believe did a still larger business, which would make something like 1,500 tons shipped from Ft. Clinton alone. So I think the figures given are altogether too small.

Mr. Clark: I would like to ask how those prices, forty to sixty cents a hundred, compare with herring prices in the fall?

Mr. Downing: A little less than now.

Mr. Clark: I mean in the fall catch, how do they compare?

Mr. Downing: A little less than the herring, but just about the same.

Mr. Clark: The herring is considered quite a fish in the great lakes.

Mr. Peabody: Regarding the price of carp I had a conversation with Mr. Ravenel last summer, and I think his point very well taken. I have known peaches to sell in the Chicago market for five cents a basket, and I have known them to sell for $5, and it depends entirely on the season and the conditions. Now Mr. Ravenel says that the proper time to eat carp is about Thanksgiving time and a little later; the carp then has value in New

York and brings a high price, but that it is marketed at all seasons of the year, and as it is a good shipping fish it is shipped at all times, and the market is very poor for it during the months when it is more easily caught, and I think all this has something to do with the variance in the estimate of the market value of carp.

General Bryant: How is the quality of the carp affected by the water it is in? Where it is in sloughs of dead and sluggish water and becomes very warm in the summer time, is the flesh softened and does it become flabby as other fish do, or does it keep firm?

Dr. Bartlett: It goes through pretty solid.

General Bryant: The water that it is in with us is of an excellent quality and not subject to impurity.

Dr. Bartlett: You would have a good fish all the time. Carp taken out of your waters and shipped east ought to bring good prices.

Mr. Nevin: How would carp be if smoked?

Dr. Bartlett: Good.

Mr. Lydell: Are the bass in your river large or small-mouthed?

Dr. Bartlett: All large-mouthed.

Mr. Lydell: As to bass guarding their beds, I will tell you of a case of a bass guarding two beds, or rather guarding the same bed twice. After mating and spawning and when the fry were hatched and ready to swim up, I set a circular screen around the bed, but the old bass did not desert—he stayed there and stood guard around the screen. I fed him there every day with minnows, and after the fry were removed and the screen was taken away, this same bass mated there again and got a second crop of eggs on the bed, and after the second crop of fry and the screen were removed, he still continued on guard over about thirty fry that I purposely left there.

Mr. Nevin: Was it a large or small-mouthed bass?

Mr. Lydell: A small-mouthed bass.

Mr. Townsend: The statistics which are on exhibition show the shipments of carp, 3,000,000 pounds for Lake Erie amounting to $50,000 for 1899.

CONCERNING FISH LAWS IN ILLINOIS.

Urbana, Ill., June 28, 1901.

S. Bower, Esq.,

Secretary American Fisheries Society,

Detroit, Mich.

My Dear Sir: Replying to your esteemed favor of the 19th inst., requesting me to prepare a paper for the coming meeting, I beg to express my sincere regret that circumstances render it impossible for me to comply. Just at this moment my undivided time and attention are devoted necessarily to the reorganization of our warden system, in view of the fact that our newly amended law for the encouragement of the propagation of fish and for their protection approved May 11 last, goes into effect on July 1, prox. This Warden system has for some time been in a very much demoralized condition, in part from the inaptitude of the appointees, and in a greater sense from the fact that the statute made no provision for remuneration for the services rendered.

Incidentally, however, it may be of interest, in default of a formally prepared paper, if I convey to you some idea of the improved situation under which we expect to find ourselves under the operation of the amended law in Illinois. To begin with, the law will now empower the commissioners to compensate the wardens when on errands of duty. But above all the new law has an ample provision for the seizure and destruction of such devices for taking fish as are declared by the act to be unlawful. This will have a most salutary effect on all violators of the law. Hitherto it has been a practical impossibility to secure convictions in our river towns. Local sympathy ran almost uniformly with the fishermen, in consequence of which justice, juries and state's attorneys seemed impelled to override evidence, and the result was that the rights of the people were ignored and the statutes practically nullified, so that the destruction of the fish supply went on almost without let or hindrance. This exasperating state of affairs naturally demoralized the Warden service. It was useless to send a Warden to make an arrest, because the failure to impose, and collect a fine merely operated to bring the law still farther into contempt. The commission was therefore constrained to abandon prosecutions in localities where conditions such as these existed.

These exigencies inspired the commission to seek a remedy in the legislature by having introduced a new measure, the one to which I have already referred as coming into effect July 1 prox., a measure much better calculated to cope with the situation. After convincing the members of the utility of and the necessity for such legislation as the measure asked, but little difficulty was experienced in securing its passage, to take effect as already stated. One of its wisest provisions in my opinion, and the one that will yield the best results, is that which prohibits fishing within 400 feet of any dam between the 15th day of April and the 15th day of June. I mention here a single instance tnat came under my personal observation illustrating the destructiveness of the practice which this provision is intended to cure. It was at the Waldron dam, in the Kankakee river where one rod in a single day took 135 bass, most of them females. Can there be anything in the way of protective legislation more productive of good results in the perpetuation of our game fishes, than the positive prohibition of this barbarous method of taking the parent fish while on their journey seeking a place to propagate their young? We are simply endeavoring to bring the law to the assistance of these pretty and useful denizens of the water in their efforts to perpetuate their species for the benent of mankind. The destruction of game fish by indiscriminate angling from April 15 to June 15 below dams is the fruitful cause of the depletion of many of our inland streams. In a word, it is the paramount evil that has retarded the increase of game fishes in our waters.

Fish leave their winter quarters, ascend the streams early in the spring, and they find their progress retarded by various obstructions, dams being the chief and most formidable. Before these obstructions, the fish congregate by thousands, unable to proceed further. A few succeea in getting ahead by means of fishways, where such provisions are made; but the great body of them are at the mercy of the unscrupulous angler who never leaves the spot so long as a poor, heipless, hungry denizen of the water will consent to be landed in his creel. He goes home with his enormous catch, and ignorantly gloats over the destruction of millions of fishes which future generations ought to enjoy. He is unable to see an inch ahead of his nose, and to recognize the fact that he is taking out of the water the muitiplied and multiplying progeny of these helpless creatures, the stock which nature is striving to supply for the years to come.

I ought to mention that the stipulated limitation here mentioned —the sixty days between April 15 and June 15—is a compromise. It was the desire of the commission to make the limitation cover the entire time from April 1 to July 1; but the opposition was so determined that it was deemed expedient to agree to the sixty day limitation, rather than incur the risk of having the bill defeated in toto. It is wise to recognize the fact that measures of a drastic character must be brought before the people by degrees.

Another feature of our new law which we regard as of vital importance is the provision which prohibits the taking of bass with any device other than hook and line, thus making the angler the sole beneficiary of this species.

Presumably, if the sportsmen of Illinois could have the opportunity to legislate upon the question of the use of nets or seines, there would be a practically unanimous vote in favor of abolishing their use entirely. But what would be the result of that? In Illinois there are thousands of people who earn their bread almost entirely by taking the coarse fishes that the angler despises. These people would be practically thrown out of employment, and many of the river towns would feel the effects of losing a considerable portion of their population. Thousands of dollars that are invested in tackle and boats would lie and rot on the banks, and vast sums of money that come from eastern markets in the purchase of these coarse fishes would cease to pour in, for fish that refuse to be ensnared by the anglers' lure can only be taken by net or seine.

It is evident that the industry in these coarse fishes must be fostered. It is a matter of no small commercial importance. Over 14,000,000 pounds of this class of fish were taken last year within the jurisdiction of Illinois. The laboring man, earning a dollar a day, cannot pay 25 cents a pound for the finer fish taken by the angler. Carp, the much abused Cyprinoid, that has not had a word of praise from any mortal since its introduction in this continent—villified by every sporting paper from Maine to California, a nightmare for the angler, and a general all-around Jonah—will yet loom up like a Phoenix in the piscatorial horizon as the future cheap food supply for the generations that are to come. Permit me to set down here a little anecdote illustrating my opinion of the carp as a food fish, and showing that the tirade against it is mostly prejudice. Some two years ago, my esteemed colleague Col. S. P. Bartlett and myself were at Springfield endeavoring to convince the legislature that it was necessary for the Fish Commission to have a new boat, because the old one lacked capacity for the accomplishment of the work laid out for the year then ensuing. We thought we were meeting with fair success, until one of the members arose and cried out, in a ponderous voice: "That's the man," pointing to Col. Bartlett, "who introduced those infernal Dutch Carp that kill all other fish, and aren't fit for a dog to eat." We supposed we were lost; but the bill was only on its second reading, and we had anotner chance. Col. Bartlett sent to Meredosia for a twenty-pound Carp, turned it over to the chef at the hotel and gave instructions to have it well prepared and put on the menu as "Red-snapper." The instructions were followed and it came on in an artistic manner. When dinner was served, not less than twenty of the members called for "Red-snapper" from two to three times. After they discovered they had eaten Carp, our bill passed without a dissenting vote. We never heard anything more in the way of tirade against Carp during that session. I give this anecdote to show that it takes a connoisseur at least to distinguish Carp when properly prepared. Suppose we grant that it was a mistake to introduce these fishes into our waters, is it not better to take them also under the protection of our laws, to regard them as a real money producer and a source of cheap food for a large class of our people, since all this can be so readily accomplished without detriment to our game fishes?

In a word now, our new law gives the market-fisherman an opportunity to realize his revenues from August 1 to April 15 in the rivers used for commercial navigation only; all other streams and lakes will be left for the angler. With the proper enforcement of the amended law of which I have spoken, there is every reason to expect that the coarse fishes will remain abundant in our waters, and that the game fishes will increase from year to year. Thus I trust you will be able to get a faint glimpse of the fact that we are striving to do a good work in Illinois, in preserving and enlarging the means which God and nature have placed in our hands for supplying an inexpensive and healthful food for the tables of the masses and a dainty for the tables of the rich and the well-to-do. In this important work we shall progress the more the better the people—the source of our authority—understand the methods by which and the ends to which our efforts are directed.

Wishing you a pleasant and very profitable meeting, I am,

Very sincerely yours,

NAT. H. COHEN,

President Illinois Fish Commission.

STURGEON HATCHING IN THE LAKE CHAMPLAIN BASIN.*

BY LIVINGSTON STONE.

Somewhat of the mystery formerly surrounding the taking and fertilizing of sturgeon eggs on a large scale has been removed, only to be replaced by the appearance of difficulties which seem even now to be almost insurmountable. Only three years ago, it was a mystery why the net fishermen, while they caught plenty of parent sturgeon with eggs in all stages of maturity, never caught any with wholly ripe eggs in them. Now that we know the reason of this to be that ripe sturgeon caught in nets, throw all their eggs in their efforts to liberate themselves, the difficulty arises of securing the parent fish *before they throw their eggs.*

We adopted various devices, this spring, to accomplish this object. We set trap nets in the two rivers and also in the lake, but the sturgeon would not go into the trap nets. We set gill nets in various places in both the Lamoille and the Missisquoi rivers, and we had these nets overhauled every hour, night and day. We also overhauled and examined all the parent sturgeon in the pens every day, but somehow most of the ripe fish eluded us in one way or another before their eggs could be secured. In some instances, even when we had a night guard on duty, parent fish caught at night by the fishermen, and put in confinement were stolen before morning, the high price paid for caviare sturgeon (i. e., female sturgeon with nearly ripe eggs in them) being a sufficient incentive to poachers to incur unusual risks in stealing them. At other times, ripe fish gilled at night and safely conveyed to the pens by the fishermen would spawn in confinement before morning, thus eluding the spawn takers. At another time,—this was on the 13th of May,—a large ripe female sturgeon of nearly a hundred pounds in weight was found

* The operations referred to in this paper were conducted under the auspices of the United States Fish Commission, by the writer, very ably assisted by Mr. Myron Green, in Northwestern Vermont, in the Missisquoi River and the Lamoille River, tributaries of Lake Champlain, and in the Lake itself.

in our Missisquoi River pens. There were three able bodied men present to handle the fish besides the writer, who stood by, ready with the spawning pan. The fish was no sooner lifted from the dip net by the men on the stripping platform, than with two terrific blows with tail right and left, she sent her eggs flying across the platform to the distance of a rod or two, in the meantime struggling so violently that it required the combined efforts of the three men to hold her. Finally having subsided to a degree of comparative quietness, the few remaining eggs in her—perhaps 20,000—were taken, but though these were successfully hatched, the stripping of the fish was, of course, a failure, as not more than four per cent. of the eggs were taken. At still another time, three large female sturgeon, supposed to be fully ripe were caught. On holding the fish up by the tail, the eggs sagged in the abdomen as with a fully ripe salmon, and in order to ensure our not losing these eggs as others had been previously lost, two of these fish were knocked in the head and instantly killed, when, to the great dismay of the spawn takers, the eggs were found after all, not to be sufficiently mature to be fertilized. To avoid a repetition of this risk, the third fish, which appeared to be the least ripe of all, was put in confinement to ensure the further ripening of her eggs. This fish spawned that very night.

The above instances illustrate how elusive and disappointing the sturgeon were, when an attempt was made to get their eggs, and now many difficulties presented themselves, even after their mysterious character had been removed.

The difficulties did not prove wholly insurmountable, however. All the fishing for spawning sturgeon had been done, this year, on the Missisquoi with nets. On the Lamoille, we encountered something different. Near the south bank of that river, about four miles from its mouth, and half a mile from the West Milton postoffice, Vermont, is a place known to the residents of that neighborhood as the "Sturgeon Hole." Here the main body of the river rushes through a rocky gorge not over twenty or thirty feet wide, with precipitous walls of solid rock on each side. Just below the gorge is a hole about forty-five feet deep, apparently shaped somewhat like a boat, in which the spawning sturgeon collect, usually very soon after their appearance at the mouth of the river, but most probably when the water reaches the right temperature for spawning. The water is too deep to spear the fish here and nets cannot be used, but the sturgeon are taken by twitching them up with hooks. We watched this hole night and day, after the appearance of the sturgeon at the mouth of the river, and obtained many breeders from the "Hole" after they had begun to collect in it, twenty-seven being caught on the 22nd of May, the temperature of the water being 68 degrees F. These were all or nearly all ripe males, but on the afternoon of the 23d of May too entirely ripe females were hooked up. The fish not struggling violently at first, the men stopped the flow of eggs by stuffing their handkerchiefs into the vent. The fish were then towed across the river, where the males had been secured, and were instantly killed by being knocked in the head. Their eggs were taken and treated like pike perch eggs, as to impregnating, mixing with milt, rinsing, etc.

In the meantime, a rude hatchery had been constructed on the north bank of the Lamoille, with a battery of twenty-two jars, a short distance from the Sturgeon Hole. The eggs now obtained were all placed in the jars, where they appeared to do finely. The next day, the writer took a few thousand over to the hatchery at Swanton, where they subsequently hatched out without difficulty. The remainder were left at the temporary hatchery on the Lamoille. The hatching water for our battery here was obtained from a spring brook, which rose, I think, about a mile to the north. Before locating the hatchery at this point, Mr. Green and the writer had many discussions as to whether the water in the brook might not get too cold for the sturgeon eggs. There was no other supply obtainable, however, with the limited means at our disposal. It was "Hobson's choice,"—take that or nothing—so we took the hatching water from the brook. For a time, the weather remained fairly warm, and the eggs did well. It was found on examination of the eggs, when the form of the fish first appeared in the embryo, that nearly ninety per cent. of the eggs were impregnated. Then there came a frost, one morning, and the water dropped to 50 degrees F. The next night, there came another frost, and the water fell to 45 degrees F., and then the sturgeon eggs all died. It was a bitter disappointment. We had struggled against great discouragements, and now we thought we were on the eve of a great success, instead of which we were on the eve of a great failure.

A consignment of eggs which had been in the meantime sent to Cape Vincent Station met with the same fate, the water of the St. Lawrence used at this station being also comparatively cold at this season.

We afterwards discovered a spawning ground of the sturgeon on the shore of Lake Champlain, a short distance south of the mouth of the Lamoille. Here is a well-protected bay, with a beach sloping very gradually out to deep water. In the shallow waters of this bay, in water not over three feet deep, strange to say, the sturgeon come to spawn in the month of June. Here we found them spawning in plain sight from the shore. We set trap nets and gill nets here, and caught many ripe males and several ripe females, the first week in June, but did not succeed in collecting any impregnated eggs.

I may add here that the sturgeon eggs that we took averaged 850 to the fluid ounce. They are apparently amorphous as to shape, and of a dull and dirty color, but this appearance is given them by a cobwebby film which surrounds each egg. The film can be easily separated from the eggs by squeezing the egg out of it with the fingers, and the egg is then seen to be spherical, clear, and crystalline like other fish eggs, and not very different in size from white fish eggs, though perhaps somewhat larger.

The eggs come very easily from the parent fish when they are ripe. They are somewhat glutinous, but if taken from a freshly caugh fish, they are no more so than pike perch eggs, and if treated as pike perch eggs are when taken, they will give no trouble in sticking together, and will easily hatch out eighty per cent. or ninety per cent. of healthy fry. The eggs that were taken at the Swanton hatchery hatched in seven days in an average temperature of 65 degrees F. Their mobility was so much less than that of pike perch eggs that it took a stream of water running through a three-eighth inch rubber tube with about a six foot pressure to keep them in motion in the hatching jars. The young fry are hardy and very active, but if they are to be confined in tanks or troughs, the screening must be very tight, as they can work themselves through an extremely small crevice.

Allow me to state in conclusion, as I have already done, in my annual report to the United States Commissioner of Fish and Fisheries, that the following points in regard to Lake Sturgeon and Sturgeon hatching may be considered as pretty well established:

1. The Lake Sturgeon go up the tributary rivers of Lake Champlain to spawn. They ascend different rivers at different times, the time for each river appearing to be determined by the temperature of the water. The river that the spawning sturgeon of Lake Champlain first ascend is the Missisquoi, in the extreme northwestern corner of Vermont. They go up this river very soon after the pike perch have finished spawning in the river, which is usually the latter part of April. The largest number of ripe fish appeared about May 13th. The spawning sturgeon were all out of the river by May 20th.

The Lake Champlain sturgeon ascend the Lamoille, a Vermont river which flows into the lake about thirty miles south of the Missisquoi, somewhat later. This year their first appearance at the mouth of this river was about the middle of May; and they collected in the Sturgeon Hole in the greatest numbers for spawning on the 23d of May. They had all left the river by the end of May.

2. The Lake Sturgeon spawn in the shallow waters of the lake in June. At least, there is a spawning bed in the shallow water of the bay just south of the mouth of the Lamoille, where the sturgeon come to deposit their eggs. Parent fish collect in this bay to spawn about two weeks later than they are found in their greatest numbers in the Sturgeon Hole of the Lamoille. The largest number of ripe ones was observed on June 4th. By June 15th, all had left the spawning grounds of the bay.

3. As far as we have observed, the Lake Sturgeon will not spawn until the water reaches a temperature of 60 degrees F. In our experience on both lake and river, we have never found sturgeon spawning in colder water than this. We are consequently led to believe that they *require* water at or above 60 degrees F., though of course, this must be accepted only as an inference.

4. The Lake Sturgeon spawn at various periods later than they do in the bay just mentioned, as is evidenced by the fact that

we caught parent fish in June with eggs that would not have been ripe for a fortnight, and others with eggs that would not have ripened for a month or longer.

5. The parent sturgeon do not seem to ripen their eggs well in confinement, unless they are *very nearly ripe* when captured. We found that the eggs of the fish that we kept in our pens caked together and otherwise became very poor, if the fish were too long confined, and the eggs would probably not have been susceptible to impregnation even if they had ripened enough to be extruded from the fish. This point must not be accepted yet as conclusive, for it is quite probable, I think, that means will be found eventually for keeping sturgeon in captivity without injuring their eggs till they are ready to spawn.

The spawning season at the various spawning grounds of the Lake Sturgeon is very short. They are doubtless spawning somewhere all summer, but at any specified spawning ground, I do not believe that they are in the act of spawning over three or four days. I have set wide limits in this paper to the period that the spawning sturgeon remain on their spawning beds, in order to be on the safe side, but I think that on a more thorough investigation, these limits will be very much narrowed.

7. Unless some device has been adopted for forcibly retaining the eggs in the parent sturgeon, it seems to be almost useless to attempt to strip a ripe fish after it has once been lifted out of the water alive. A few seconds of time and a few powerful strokes of the tail are sufficient to throw all their eggs to the four winds. If the eggs are ripe, it must be ascertained before the fish is taken from the water, or the instant it is lifted from the water. The vent can then be plugged, the fish put in a straight-jacket, and the eggs taken without difficulty. We adopted various ways of "plugging" the parent sturgeon, but after all, the most effective way was to stuff a handkerchief instantly into the vent, and keep it there. If this is done quickly enough it will be a success. If something of the kind is not done or if the ripe sturgeon is given any time to struggle, if only for a few seconds, the eggs will be lost.

8. The eggs of the Lake Sturgeon, once they are taken, are easily impregnated. It has frequently, in fact almost always

happened, that when a straggling ripe female has been found, or when the females have been ripened in confinement, ripe males for fertilizing the eggs could not be found. On the other hand, if the ripe females are captured during the three or four days during which they are collected on the spawning beds, ripe males will be found in abundance. When we caught the ripe females in the Lamoille "Sturgeon Hole," we could have taken a quart of milt from the males, if it had been necessary.

9. The eggs of the Lake Sturgeon are easily hatched. Any of the hatching jars in use for pike perch and white fish are suitable for the purpose. Run a stream of water through the jars with sufficient pressure to keep the eggs in healthy motion, and they will hatch without trouble and without much loss. It is highly probable that eighty per cent or ninety per cent. of sturgeon eggs taken under favorable conditions will be hatched in the future.

NEW PENNSYLVANIA LAWS FOR THE PROTECTION OF FOOD FISH.

BY DR. BUSHROD WASHINGTON JAMES, (A. M., LL. D.),
Of Pennsylvania.

For a number of years the Pennsylvania Fish Commissioners and the Pennsylvania Fish Protective Association have been working in harmony to induce the Legislature to aid them by law in protecting food fish from destruction. Time after time bills have been laid before our law makers, and some have been passed, which aimed at guarding the fish from depredation.

The United States Fish Commission has spent large sums of money and much scientific labor in propagating and distributing the most desirable kinds of fish in numberless streams and rivers along either coast as well as in the interior states. Yet their efforts have been but partially successful because of the persistence of fishermen and other sportsmen who will in season and out of season, catch the half grown and even very young fry of those which have been carefully hatched and planted for future benefit. The two societies named have used their utmost endeavor to aid in keeping the few laws that have been passed but they felt their inefficiency because of the imperfection of the Legislation.

Several times they have jointly tried to have a certain set of laws passed which they codified with most careful consideration of every point requisite to secure the much desired results. But until this year efforts have been almost in vain, notwithstanding the earnest personal attention given by several members of the Board of Fish Commission and of our society. The writer was for years chairman of the committee appoined to formulate a new code of laws and to carry them through. When he became president of the Pennsylvania Fish Protective Association he appointed another committee on Legislation of which Mr. Howard F. Chase is chairman. This committee has acted with a joint committee from the Board of State Fish Commissioners, Mr. William E. Meehan, chairman. It is with satisfaction therefore that he finds the laws actually passed and made available for the future protection of the beautiful and delicious denizens of our noble rivers and lovely mountain streams.

The act, for obvious reasons, does not embrace the border waters of Lake Erie or the Delaware River, for all other water ways in the state it goes into effect immediately. It embraces the following:

Section 1. These are game fish: Salmon, all species of trout, black and Oswego bass, crappie, grass, strawberry, white and rock bass, blue pike, pike-perch or Susquehanna salmon, pike, pickerel, sunfish and muscallonge. These are called food fish: Shad, white fish, herring, lake herring, cisco, alewife, sturgeon and striped bass or rock fish.

Section 2. Game fish may be caught only with rod, hook and line or hand line not having more than three hooks. Food fish only with devices specifically named. Fine, $25.

Section 3. Open season for brook trout, April 15th to July 31st; lake trout, January 1st to September 1st; black bass, sunfish, all species of bass except striped bass, pike-perch or Susquehanna salmon, pike, pickerel and muscallonge, June 15th to February 15th. Fine, $10 for each fish. (Note.—Striped bass or rock fish, shad and herring, may be caught with rod, hook and line or trolling line at any time).

Section 4. Must not catch or kill white rock or strawberry bass less than five inches in length; brook trout, less than six inches; black bass, seven inches; lake trout, Oswego bass, striped bass or rock fish, blue pike, pike-perch or Susquehanna salmon, pike, pickerel and muscallonge, less than nine inches in length. Fine, $10 for each fish.

Section 5. Unlawful to catch more than fifty brook trout in one day. Fine, $10 for each fish over that number.

Among the greatest enemies to the protection of the fish were nets, which scooped up all kinds and all ages of the fish, from which the large ones were selected and the others either thrown away or wasted as bait for larger fish in deeper streams. Eel pots also were used to the detriment of the young fish. The following laws concerning them, if properly enforced will be very beneficial to the planted fry:

THE USE OF NETS AND OTHER DEVICES.

Section 6. Eel pots made of wicker work, five feet long, opening two and one-half inches wide, lawful except in trout streams.

Section 7. Lawful to use dip nets, spanning five feet, two inch mesh, except in trout streams, during March, April, May, October, November and December, for carp, suckers, catfish and eels. Other fish to be returned. Penalty, $10 each fish and forfeiture of nets, etc.

Section 8. Lawful to use fyke nets, without wings, except in trout streams, not set to openings in dams or to wing walls, for carp, suckers, catfish and eels, in March, April, May, October, November and December, and in shad streams only in March, April and May. Each net must have metal tag with name and residence of owner. Other fish to be returned. Fine, $25 for illegal placing, $10 for each fish unlawfully kept and forfeiture of nets illegally set.

Section 9. Lawful to use seines, mesh 1½ inch, except in trout streams and natural lakes, for carp, catfish, suckers and eels, provided bond amount of $200 be first given Fish Commission, other fish to be returned. Fine, $100 and six months' imprisonment, also forfeiture nets, boats, etc.

Section 10. Lawful to fish for herring, shad, striped bass or rock fish and sturgeon with seines or other nets, from January 1st to June 20th, except between Saturday sunset and Sunday midnight. Meshes for herring nets, 2¼ inches; for shad and striped bass or rock fish, 4 inches, and sturgeon, 10½ inches. No net to be set or fastened at both ends. Fine, $100 and forfeiture of nets, boats, etc.

Section 11. Lawful to use lay-out lines from sunset to sunrise, except in trout streams, for catfish, eels, carp and suckers. In trout streams, with one hook only, each line to have tag bearing name and residence of owner. Line must be on bottom. Cut or dead bait only. Other fish than those named to be returned. Possession of other fish by operator of lay-out or single line, illegal. Fine, $25 and forfeiture of lines.

Section 12. Unlawful to kill young sturgeon. Fine, $20 each fish.

Another manner of obtaining large quantities of fish is by screens, fish ways, or other devices for catching and detaining them on their way along the rivers either to their spawning grounds or on their outward course to deep water. The law relating to these is made quite plain. We quote,

FISHWAYS, SCREENS AND OBSTRUCTIONS.

Section 13. Fish Commissioners may compel erection of fish ways in all dams, and collect cost from owners. Also fine $50 a month.

Section 14. Fish Commission may order net or screens across race ways or flumes to keep fish from entering. Fine, $50, and Commission may place such nets and collect cost.

Section 15. No fishing except with rod, hook and line within one-fourth of a mile of a fish way, and no obstruction to be placed which will prevent free passage of fish. Fine, $100 and forfeiture of all devices used.

Section 16. All obstructions to fish ways to be removed by Commissioners, and builders fined $100.

There was a great necessity for regulating the sale of game fish and for specifying the times at which artificially bred fish were to be sold, as some proprietors of fish ponds had the idea that they could control the matter without legal interference, hence the importance of the following sections:

REGULATING SALE OF GAME FISH.

Section 17. Unlawful to purchase, sell or offer for sale any dead game or food fish, except during open season and six days thereafter. Fine, $10 for each fish.

Section 18. Unlawful for any proprietor, manager, club or agent of any market, hotel, boarding house, eating house, saloon, to buy, sell or expose for sale any speckled trout, or to employ any one to catch or fish for trout, provided that nothing in the section shall be construed to prevent during the open season, any person or company from selling trout or speckled trout bred and raised artificially. Fine $25 for each offense.

Section 19. Lawful for any person, company or corporation engaged in the cultivation of trout to sell trout at any time of year for stocking purposes only on condition that the fish when transported are accompanied by a certificate of Justice of the Peace certifying that said trout are raised by the owners for artificial propagation only. But no company may sell trout for food purposes during close season. Persons transporting or selling shall be subject to a fine of $100.

Section 20. Fish caught unlawfully must be returned unharmed to the water. Fine $10 for each fish.

Another particular difficulty meeting the fish hatcheries and private fish ponds is the injury done by trespassing. It would be well if the law relating to the trespasser were posted in plain view of the fisheries and hatching places. It reads as follows:

IN RELATION TO TRESPASS.

Section 21. Unlawful to trespass with intent to fish on a State fish hatchery, or on property of corporation operating hatchery not for profit, provided no screens are maintained to prevent free passage of fish, also such property must be indicated by signs. Persons may not fish on such property from roadways or bridges, and domestic fowls tresspassing may be killed after five days' notice to owners. Penalty for trespassing on such land $25.

We think it doubtful if the public have ever thoroughly understood that the Fish Commission is a public institution created for the general benefit and not for the community of sporting men as it has been believed by a few who denied the importance of any legislation concerning fish and eels. The sections here quoted put the matter plainly:

DISTRIBUTION OF FISH AND PUBLIC WATERS.

Section 22. Unlawful to apply for or to be concerned in applying for self or another any game or food fish for waters in which the public are not allowed to fish. Eggs exempted, also fish and eggs for schools. Fine $25.

Section 23. Free waters to comprise those declared navigable by the acts of Assembly or public by common law, and such others as are made public by owners by grant or usage.

Section 24. The Fish Commissioners may give preference in distributing fish to waters in lands owned by the state.

Section 25. Whenever fish are planted in waters on written application of owners or lessees such waters are declared open to the public for fishing purposes thereafter. Provided, that the section shall not be construed to permit any person fishing in such waters from the banks without permission of owners or lessees; small spring runs tributary to trout streams not included.

At the time of the introduction of German Carp into our fishing streams it was supposed to be a food fish innocent of any very pernicious habits, but experience has shown that the larger fish are not agreeable for food and they do unquestionably destroy, or devour the young of our far more desirable fish. Old fishermen along the borders of our inland rivers or creeks bewail the presence of the "great rough fish." They point to the coffee colored waters of the once silvery streams and say that they never were so until the carp were put there. One old man on the Perkiomen said: "There aint no fishin' any more; what the cussed carp don't eat he frightens away with his lashin' on the bottom of the creek." Whether this be true or not the turbid waters must have some cause for the new feature in their coloring. The Fish Commission has doubtless solved the problem as the following sections would denote:

GERMAN CARP UNLAWFUL FISH.

Section 26. Unlawful to fish with any poison or explosive, and no explosive shall be used in waters except for engineering purposes, after written permission is obtained from proper national, state, city or county official. Fine, $100 and imprisonment for six montns.

Section 27. Unlawful to plant German carp or use this fish for bait. Fine, $100.

Section 28. Unlawful to plant pike, pickerel, black bass or carnivorous fish in waters inhabited by trout without consent of owners and Fish Commissioners. Fine, $100.

Section 29. Bait fish may be caught by minnow nets for angling or scientific purposes, and game fish during close season by owners of water for stocking other waters; provided such netting is done under supervision of the Commissioners or authorized representatives. Commissioners may also remove injurious fish with nets at any time.

There are times in which valuable food fish fall off in quantity with the danger of extinction if some means is not provided for their defense. The following law was formulated to meet such emergency:

OTHER FISH THAN THOSE SPECIFICALLY NAMED.

Section 30. The Fish Commission may declare by public proclamation a close season in any fish not specifically named in the act; provided such close season shall not prevail for more than three years. Fine for catching such fish in close season, $25.

There are fishes in our rivers that are regarded as good for food but which are not included in the species that are under the direct protection of the society. These are free to be taken at any time considered seasonable, providing the protected varieties are left unmolested, it being stated in a former section of this act that any so taken shall be returned to the water. The section relating to free fishing is as follows:

Section 31. Fish not specifically named in the act as game or food fish may be taken at any time of the year with rod, hook and line or hand line not having more than three hooks; provided this does not conflict with the conditions of the previous section.

Section 32. The prohibitions and penalties in the act do not apply to the Delaware river or Lake Erie

Having thus made plain the laws regulating the catching of the food fishes which have been considered of sufficient importance to require the attention of such a body of men as the government now upholds, it was deemed advisable to form laws to guide such officers as were required for the maintenance of these codified laws, therefore the following laws were adopted showing clearly the officers and their duties; we quote in full:

DUTIES OF FISH WARDENS AND OTHERS.

Section 33. Fish Commissioners, Fish Wardens, Sheriffs, Deputy Sheriffs and constables, special officers or any peace officers are authorized and commanded to destroy any device used contrary to law, and persons placing devices or fishing illegally may be arrested without warrants. Arrests may be made on Sunday and proceeded against as soon as possible thereafter.

Section 34. Any Sheriff, Deputy Sheriff, constable or any peace officer who shall refuse or neglect to proceed with sufficient force to remove and destroy illegal devices shall be deemed guilty of misdemeanor and subject to a fine of $500.

Section 35. Persons interfering with any officer in discharge of his duty shall be subject to a fine of $100, or be imprisoned not less than three months, or both, at the discretion of the Magistrate of the court.

DISPOSITION OF FINES.

Section 36. One-half of every fine collected recovered, to be paid to informer, the other half to the Fish Commission for fish propagation and protection.

Section 37. Possession of fishes out of season, or illegal size, or illegal nets, considered prima facie evidence of guilt.

Section 38. Any Justice of the Peace, Alderman or Magistrate, upon information or complaint made by affidavit, is authorized and required to issue his warrant, to cause such person or persons to be arrested and brought before such Magistrate, etc., who shall hear and determine the guilt or innocence of the accused, who, if convicted, shall be sentenced to pay fines or penalties, and in case the defendant or defendants neglect to pay at once, the defendant or defendants shall be sentenced to undergo imprisonment in the county jail for the period of one day for each dollar of fine so imposed and unpaid.

Section 39. The Fish Commission may close a newly stocked stream or lake for three years, on notice given in at least two newspapers of the county, any person fishing such waters subject to a fine of $10 for each fish taken.

Section 40. All actions must be brought within one year.

FISH COMMISSIONERS.

Section 41-42. The Governor shall appoint six Fish Commissioners, who care for the fish cultural and protective work of the state. They have power to enforce the provinces of the act, to appoint fish wardens and issue bulletins on fish cultural matters.

Section 43. There shall be not more than twelve regular wardens, at such salary as Commissioners may determine, who shall be subject to duty at all time and in any part of the state. One of these shall be a chief, with headquarters at Harrisburg.

Section 44. Wardens, Sheriffs and constables are given the right of search.

Section 45. No salary for wardens shall in the aggregate exceed the amount appropriated by the state specifically for this purpose.

Section 46. Special Wardens, without salary, may be appointed on the application of any properly organized fish protective association or associations with established hatching houses.

Section 47. All wardens are subject to removal at any time by the Fish Commissioners.

These laws and regulations, of course, have been codified and passed into active service in and for the State of Pennsylvania. But it may be possible that other states will view them with favor and follow with equally beneficial legislation. This subject, it will be remembered, was under consideration some years ago and a committee was formed with the hope of inducing the numerous states to adopt uniform laws on this important subject.

BROOK TROUT NOTES.

BY W. T. THOMPSON.

Our country is peculiarly fortunate in the great area of its trout waters. There are but few localities, excepting the extreme south and some of the prairie states which cannot boast of one or more suitable streams.

Varieties and sub-varieties are scarcely less numerous than are the waters. Each section has its aspirant for the popular favor, some favorite son as it were, whose peculiar claims are always loyally, if not consistently paraded for public view. They also have the "Brook Trout." You will find it the same story everywhere, always: the "Brook Trout" and—some other trout. The uninitiated finally concludes there are but two divisions: the "Brook Trout" and the *other* trout.

I wish to call attention to two points mentioned in my paper last year:

1. *Early feeding of fry.* Fry should always be taught to feed before they can swim, when you see them begin to withdraw from the huddling, wriggling mass and take up a separate and individual existence, scurrying independently around the bottom of the trough, you may know that, in response to nature's demands, they are looking for food. Give it to them, no after care can make amends for neglect now. They require but little at a time. Give it to them in homeopathic doses. Don't foul your troughs. Brook Trout, in common with some other members of the Salmonidae will begin to feed from one to three weeks, varying with the water temperatures, before they can swim. Try it. Try it yourself. Don't entrust this most important work to some one simply because he can't do anything else satisfactorily. Mr. J. W. Titcomb, our former president, has a most delightfully dry vein of humor which he taps on proper occasion as when he remarked last summer during his illustrated lecture at Woods Hole, in explanation of a certain lantern slide: "We once had a very lazy man at St. Johnsbury. I had heard that it took a lazy man to feed fish, so I tried him." Adding with a

tinge of pathos in his voice: "He isn't with us now." The tone, supplementing the picture, told the whole story.

2. *Care of weaklings.* Quite recently I talked on this subject with a fish culturist, who bears a most excellent reputation for careful, conscientious work. He lamented the difficulty and tediousness of feeding the weaklings who had fallen back to the tail screen. Said he: "I can't feed them there satisfactorily so I take them up with a net and carry them to the head end before I feed the trough." "But are they not back at the tail by the next feed time?" "Yes, that's true, they are and it takes considerable labor to repeat the operation each time. I suppose Supt. Blank thinks I consume a great deal of unnecessary time in so doing, but I can't feed them with any measure of success otherwise." Troughs need constant thinning, when you have these weaklings in the net, why not transfer them to a different trough along with other similar unfortunates thereby really combining in this one act the three operations of thinning, sorting and caring for the weaklings. Give these latter several salt baths to cure the frayed and fungused fins and heal the congested gills. A little extra attention in feeding and you soon have a trough of average fry out of your hospital. Visitors frequently comment on the almost entire absence of fish at the lower end of our troughs. Yet up to the present time, we have done no sorting except by this simple method. Always do your thinning from the tail end. Leave your strong head-enders together. Feeding is greatly facilitated as well as simplified. We rarely consume thirty minutes in thoroughly feeding about 125,000 trout and salmon fry, now being carried to the fingerling stage, and occupying some thirty troughs and ten ponds.

Transferring from trough to pond. One great drawback that the young fish culturist experiences is the difficulty of finding recent text books. Our authorities are largely out of date, their methods obsolete. Quoting from a standard authority: "The rearing ponds are stocked gradually, 500 to 1,000 being placed in the pond and trained to take food before more are added, as that number can generally find enough food to subsist upon until they learn to take artificial food. When they have been accustomed to hand feeding, another 1,000 fish are added and in about ten days 2,000 more, this practice being continued until the pond is stocked with the desired number." From another venerable authority on the same subject, we learn that: "A certain fashionable woman owned a most wonderful lap dog, A most *remarkable* creature, possessed of every virtue of his kind save, save one—Alas! poor Fido had a long silky tail while fashion decreed that only bob-tails should be worn. Necessity was ever the mother of invention. Early one summer morning, Fido's neighbors were aroused from their slumber and startled by the most heartrending yelps and nowls, then all was quiet. Fido was not in evidence that day. The next morning the yelps and howls were repeated, curiosity was aroused. Neither mistress nor dog appeared. The strange noises were repeated daily for a week or more. Then the mystery was solved. Fido had a *bob tail!* In response to inquiries, his fond mistress tearfully said: "It would hurt the poor little dear so to take it all off at once, so I just cut off a tiny little piece each morning." Summing up the consensus of authority quoted, it would seem to be established beyond question that had the whole ten thousand dogs been placed in the pond at once, the fish's tail would have been bobbed in infinitely less time and with less suffering on the part of the fish culturist. Do you know, I firmly believe that our fish cultural authorities are as much opposed to revision as an old time blue Presbyterian.

When will the harvest be? No question is more frequently asked than: "How many years does it require for these little fellows to get big enough to catch?" It is both a reasonable and practical one, and yet it is one that is rather difficult to answer definitely. It is one I ask of the members of this society. "How long does it require to grow a fish of angling size from fry?" Two years? Three years? In New Hampshire they will tell you "One year." Qualifying it however by adding: "Under favorable conditions." For two years past the sporting papers as well as the local press of New England have been full of the great loss of trout throughout that section caused by the unprecedented drouths of 1899 and 1900. Many stated that there would be no brook fishing within three years, others took even a more gloomy view claiming that it would require a greater period of time simply to replace the brood stock. Never was there a more favorable time to thoroughly test the value of planting and at the same time to answer the above question by a practical demonstration. In the spring of 1900, the United States Fish Commission made heavy plantings of large, vigorous, well fed fry from one to two inches long, followed by a summer distribution of two to four inch fish and winding up in November and December with trout some of them even then above the usual five and six inch limits. This work had been done so quietly that few other than those actually engaged in the distribution and planting were aware of this new factor. Hitherto nothing but unfed fry had been planted. The arrival of the open season scarcely created a ripple of excitement amongst the anglers. Conditions and results though are best described in the accompanying letter from Mr. W. H. Beasom, a prominent citizen and former mayor of Nashua, as well as an ardent sportsman.

Nashua, N. H., July 1st, 1900.

Mr. W. T. Thompson, Nashua, N. H.

Dear Sir:—For the past twenty-five years, with possibly three or four exceptions, I have fished for trout in the brooks around this city. During this period the number of anglers has increased to such an extent, that about ten or twelve years ago, I came to the conclusion that nothing except regular and intelligent restocking of the brooks would save the trout from extermination—or at least diminishing the supply to such an extent as to make angling a doubtful luxury. In company with a friend, Mr. Geo. F. Andrews, I applied for fry from the state hatchery, they were distributed and each year since I have with Mr. Andrews or others planted from 15,000 to 25,000 annually. If I had any doubts as to the benefits of restocking—which I did not—they would have been removed by the results of this season's catch. The seasons of 1899 and 1900 were extremely dry ones, some small brooks drying up for nearly their whole course, while others were dry for quite long intervals—as I found when woodcock shooting in October, I did not see any dead trout, but it is fair to assume that many died as our trout are not good tree climbers. During 1899 the streams had a good supply of fry planted—but as I recollect it, the fishing of 1900 was below the average—or at least not very good. In the summer of 1900 (Note, Aug. 8), the United States Government Hatchery had a quantity of fish measuring from two to four inches in length which I had the pleasure to assist in planting in nearby streams. All previous plantings had been fry about one inch long. The fall of 1900 was even dryer than 1899 and fishermen were apprehensive of results this year. To our surprise and pleasure, the fishing has been better this season than for years past, especially as to size of fish. A larger number of trout weighing from one-half to one pound has come under my notice than for years—while a large number running from six to nine inches have been caught. In fact any one with a knowledge of fishing can get a few of fair size nearly any day. In speaking of a well known and much fished brook, one of our oldest anglers said: "I have known and fished that brook for twenty years and never knew the fishing to be better than it is today." Now one swallow doesn't make a summer—but my personal opinion is that this extra fishing after unfavorable conditions is largely, if not entirely, due to the planting of well grown hardy fish instead of the fry usually distributed. To be sure fry were planted as well, and I firmly believe fry planting to be of value, but if we could have from 25 to 33 per cent. of the total of fry in well fed trout from two to four and one-half inches long, I firmly believe the results would be more substantial in every way.

Yours truly,

(Signed). W. H. BEASOM.

Possibly some of you may not agree with Mr. Beasom in his conclusions, may not think them sufficiently warranted from the evidence. It is true this is largely circumstantial. I admit that brook trout yearlings weighing one-half pound and upwards sound somewhat like fish stories. Yet with his long experience as an angler, his thorough knowledge of the conditions coupled with his general reputation as a conservative man, his opinion is certainly worthy of careful consideration.

This is a matter on which it is exceedingly hard to obtain positive proof; the difficulty of successfully marking fry when liberated, the impossibility of determining the age of wild fish when caught, but add to our perplexity. Still there are conditions under which even these perplexing questions admit of a definite solution. Such an occasion is detailed in the accompanying letter from Mr. Nathaniel Wentworth, president of the New Hampshire Fish and Game Commission, a director of this society and a man equally well known across the border as in his own New England as an expert with rod and gun.

Hudson Center, N. H., July 1st, 1901.

Dear Mr. Thompson:—Yours of June 28th, at hand. The pond I stocked last fall with fingerlings was made by building a dam across a ravine. There had never been a trout or fish of any kind in the stream above the dam before. We have some trout in this pond from this planting that will measure ten inches. I am sure they will average seven inches. They are nicely colored and very fat, showing there must be plenty of food for them in the pond as we have not fed them.

Our brooks in the southern part of the state as you are aware have been partially dry the last three summers. Notwithstanding this there have been some good strings of trout caught in the two last seasons. There is no question but what these trout are the result of the fingerlings planted from the United States Hatchery at Nashua.

Many of our brooks are infested with every enemy the trout has, from the mud pickerel down, and it is almost impossible for fry to escape them. It is impossible to get men to plant fry properly as a rule. I would give more for 1,000 fingerlings like what we got from you, than for 50,000 fry. Sincerely yours,

N. WENTWORTH.

It is not possible to rear in captivity with restricted range and somewhat unnatural food such magnificent specimens as are the gifts of nature in her more kindly moods. Still, with our long New England winters and cold waters, we have three ponds of yearlings at Nashua, reserved for brood stock, which on July 15 showed an average weight in the different ponds of from 6 to 6.4 oz. each and with numerous specimens weighing one-half pound and upwards and 10 inches or more in length which we would be pleased to show to the members of the society. An embalmed fish is but a poor illustration; but, as the mountain will not come to Mohammed, Mohammed must go to the mountain.

The brook trout holds a unique position amongst fishes, somehow this "speckled beauty" has a most peculiar and tender place in our affections. He is associated in memory with the old home, the cool sparkling brook, the ferns and the wild flowers, the singing birds and the shady nook, childhood's friends, and the dear old home folks. Ah! me, those were happy days indeed. In memory we live them all over again, by the uncertain light we can see a youth appear and softly close the door behind him. A faint glow lights up the east, he lingers a moment on the stoop. The glory of the morning possesses his soul. The cool, moist air comes up from the meadows, rich with the perfumes of the new mown hay and lingers caressingly on the brow flushed by the hasty preparations. Passing down through the orchard, his heart is thrilled by the morning hymn of the warbler, unconsciously the pure melody of the boy's heart bursts forth in answering strains. The robin, in the cherry tree, ceases his labors for a brief moment, to listen, his archly poised head disclosing a breast ruby red, as though dyed with the stolen fruit. A sharp tramp over the hills to the brook, then—the stealthy approach, the light cast, the quick rush, the long struggle, the light rod bends like a reed, every nerve quivers. It is over, he lies in the wet grass, gasping for breath, his heaving sides, richly colored and gaily marked glisten in the morning light. The fiercely gleaming eye tells of a spirit unsubdued, captive but unconquered. The wild joy of the conquest passes away leaving only a feeling of admiration. Isn't he a noble fellow! The creator *could* have made a better fish, but—in His wisdom—He did not.

MAINE AND THE SPORTSMAN.

(Accompanied by Lantern Slides).

BY A. H. DINSMORE.

With the anticipation of much pleasure in the task, I began in the fall of 1900 to collect material for a set of lantern slides, to be presented before this meeting, illustrating the fish and game interests of my native state. My transfer from Maine to South Dakota early in the present season interrupted me in the work of securing original negatives and obliged me to rely largely on other sources for this material. The resulting slides while not all I had hoped to make them fairly represent the great fish and game regions of the state.

It is moreover, a keen disappointment to me that I am unable to be present and describe to you the scenes which have been so familiar to me from boyhood.

It is impossible for one unacquainted with the extensive forests and the great lake systems of Maine, so easily reached from the eastern and central states, to realize the vast importance of its fish and game interests. It is estimated that the visiting sportsmen annually leave in the state $4,000,000. This vast sum is paid cheerfully for the wholesome outdoor life that comes with the click of the reel, the swish of the line, the purring of the water, cut by the bow of the canoe, and the inspiration of the camp fire after the day's chase.

For the comfort and convenience of this army of sportsmen places of entertainment are provided in every part of the state, ranging from the little isolated log camp to the great modern hotel. Eighteen hundred men are licensed as guides by the state, who furnish canoes and camp outfits. Many of these men have small camps, well equipped, in favorable localities which are placed at the disposal of their patrons. To guard against forest fires, all non-resident sportsmen wishing to camp on wild land in Maine are required to secure the services of one of these men. The guides are required under penalty of fine and loss of license to co-operate with the wardens in protecting the fish and game from poachers, and to report to the commissioners the number of people guided and the amount of fish taken and game killed.

Along with all the usual facilities for the accommodation of summer company, including the best of New England farm house board, the Maine Yankee has some schemes all his own which are worth noticing. The camps of the Messrs. Young and Buxton at Lake Onawa illustrate one of these schemes, and their management is spoken of in the highest terms by those who have been entertained there. Their property consists of small, cosy, log sleeping camps or lodges clustered around a large, log dining camp with suitable kitchen annex. Good fishing and hunting can be had close by the home camps which are located but a few minutes' walk from telegraph, express and postoffice and railway station. For the benefit of those who wish to penetrate further into the wilderness, camps are located, equipped and provisioned on the principal ponds and streams within a radius of twenty-five miles.

The camps of the Debsconeag Fish and Game club are operated on a similar plan, except that in the end they aim to serve club members only. At present, however, they are open to the public. These camps are situated at First Debsconeag Lake, fourteen miles by steamer and four by canoe, from Norcross on the Bangor and Aroostook Railroad. Forty lakes and streams may be fished from then and the hunting is as good as the state affords.

Another special outing that is very popular in Maine is the steamer trip on Moosehead Lake. Steamboats accomodating from six to twenty persons may be chartered at prices ranging from $10.00 to $15.00 per day. They are fitted with everything necessary for cooking and furnished with good berths. A party may live on one of these boats as long as they choose, go where they wish on a lake forty miles long by fifteen to twenty wide, and be absolutely certain of good fishing in season. The fishing is undoubtedly responsible for a much larger influx of visitors, and of far greater value to the citizens of the state, than the hunting. While good bass, pickerel and perch fishing may be had, trout and salmon are the great drawing cards.

Brook trout are found throughout the lake regions and here reach their maximum size. Lake trout, or togue, as they are called in Maine, are taken in many of the lakes, but are generally little esteemed by either resident or non-resident sportsmen. The food quality of this fish varies greatly in different localities.

As is well known, Maine is the home of the landlocked salmon, although now found in many sections of the state, it was originally confined to four localities, viz. The Sebago waters, near Portland, the waters forming the Union river in Hancock county, those forming the Sebec river in Piscataquis county, and the Schoodic lakes, on the eastern boundary. The Sebago and Union river waters furnish the largest fish but they are much more numerous in the Schoodic and Sebec regions. At Cowyard Falls on Shippond stream, between Onawa and Sebec lakes, one may at almost any time during the summer and early fall months count salmon by the hundred as they attempt to scale the falls. For convenience the slides have been arranged in such a manner as to divide the state into three sections as follows:

1. The Rangeley and Dead river region. This country lying in the western part of the state is easily reached from Boston and affords some of the finest trout and salmon fishing to be found. It contains many lakes, large and small, and is popular as a summer resort. The hunting is also excellent.

2. The Bangor and Aroostook region, including the great northern counties of the state. It is of vast extent, containing 15,000 square miles. In it lie a thousand lakes and ponds, all well stocked with trout or salmon or both.

One of the most attractive features of this great North Land is the opportunity afforded by this network of lakes, ponds and streams for extended canoe trips. The so called West Branch trip from Moosehead lake down the West Branch of the Penobscot river is 125 miles long, while the Allagash trip from Moosehead lake to Van Buren is 200 miles. This trip may be extended down the St. John's river to the city of St. John in New Brunswick.

3. The Washington county region reached by the "Sunrise Route," the new Washington county railroad. This section was opened to the non-resident sportsman in 1899 by the completion of this road. It lies in the south-eastern corner of the state, and contains the famous Schoodic salmon waters.

The trout and salmon waters of Maine, with a few exceptions, are open to the non-resident sportsman from May 1st to October 1st, and the catch limited to twenty-five pounds at any one time. The best fishing is secured immediately after the ice leaves the lakes, and every spring thousands of fishermen all over the country await the telegram that tells them the lakes are clear and sport may begin.

As many of the slides relate to the game interests of the state a brief reference seems necessary.

Almost all the fishing resorts become game resorts after the 1st of October. For weeks, much of the time extra cars are necessary to move the quantities of game which the non-residents take out of the state with them. It is estimated that 15,000 deer are killed in Maine annually. About 200 moose are each year shipped out of the Bangor and Aroostook region alone.

Do you ask how the game can maintain its numbers against such slaughter? The answer is first, wise protective laws stringently enforced; second, the great timber sections back from the main water ways where the hunter seldom penetrates. These regions are natural breeding grounds where the game is seldom molested. Of course deer and moose have almost no natural enemies now. The wolf was exterminated many years ago, and the bear and wild cats are not numerous enough to do serious damage.

The increase of deer in Maine during the last two decades has been nothing short of marvelous. I can remember when it was a very remarkable event for a deer to be seen or heard of near my home at Dover. Now there are thousands of them within a radius of twenty-five miles and they are frequently seen on the outskirts of the village.

Moose, too, are slowly but surely on the gain. The illegal slaughter of moose by wealthy sportsmen—so called—who make no pretense to honor in such matters and care nothing for a fine, has been stopped by the imposition of a short jail sentence.

We will now have the lights turned off and fancy ourselves for a time in that great game land of the east, the state of Maine.

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Wilson, S. H., Cleveland, O.
Winn, Dennis, Nashua, N. H.
Wires, S. P., Lester Park, Duluth, Minn.
Wisner, J. Nelson, Jr., United States Fish Commission, Washington, D. C.
Wood, C. C., Plymouth, Mass.
Woodruff, C. B., Columbus, Ga.

Zalsman, Philip G., Paris, Mich.
Zweighapt, S., Deer Park, Haines Falls, N. Y.

HONORARY.

Borodine, Nicholas, Delegate of the Russian Association of Pisciculture and Fisheries, Uralsk, Russia.

Fish Protective Association of Eastern Pennsylvania, 1020 Arch St., Philadelphia, Pa.

Lake St. Clair Shooting and Fishing Club, Detroit, Mich.

New York Association for the Protection of Fish and Game, New York City.

Peck, Hon. Geo. W., Milwaukee, Wis.

South Side Sportsmen's Club, Oakdale, L. I., N. Y.

Sweeny, Dr. R. O., Lester Park, Duluth, Minn.

The President of the United States.

The Governors of the Several States.

Woodmont Rod and Gun Club, Washington, D. C.

CORRESPONDING.

Apostolides, Prof. Nicoly Chr., Athens, Greece.
Armistead, J. J., Dumfries, Scotland.

Benecke, Prof. B., Commissioner of Fisheries, Konigsberg, Germany.

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

Brady, Thos. F., Esq., Inspector of Fisheries, Dublin Castle, Dublin, Ireland.

Calderwood, W. L., Esq., Inspector of Salmon Fisheries, Edinburgh, Scotland.

Feddersen, Arthur, Copenhagen, Denmark.

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

Ito, K., Member of Fisheries Department of Hokkaido and President of the Fisheries Society of Northern Japan, Sapporo, Japan.

Jaffe, S., Osnabruck, Germany.

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

Landmark, A., Inspector of Norwegian Fresh Water Fisheries, Bergen, Norway.

Lundberg, Dr. Rudolph, Inspector of Fisheries, Stockholm, Sweden.

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

Malmgren, Prof. A. J., Helsingfors, Finland.

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

Olsen, O. T., Grimsby, England.

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

Senior, William, London, England.

Smitt, Prof. F. A., Stockholm, Sweden.

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

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

Trybom, Dr. Filip, Stockholm, Sweden.

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

Wattel, M. Raveret, Secretary of the Societe d'Acclimation, Paris, France.

RECAPITULATION.

Active	291
Honorary	54
Corresponding	25
Total membership	370

CONSTITUTION.

(As amended to date).

ARTICLE I.

NAME AND OBJECTS.

The name of this Society shall be American Fisheries Society. Its objects 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 all 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 one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar 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.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

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 office until a year after the expiration of their term; a Corresponding

Secretary, a Recording Secretary, a Treasurer and an 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 said meeting.

TRANSACTIONS

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED TWO

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-first Annual Meeting

AUGUST 5, 6 AND 7, 1902.

Headquarters of the Meeting, Hotel Victory, Put-in-Bay, Ohio.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1902.

Officers for 1902-1903.

President, - - - -	GEORGE M. BOWERS, Washington, D. C.
Vice-President, - -	HENRY B. WARD, Lincoln, Neb.
Recording Secretary, -	GEORGE F. PEABODY, Appleton, Wis.
Corresponding Secretary, -	JOHN E. GUNCKEL, Toledo, O.
Treasurer, - - -	C. W. WILLARD, Westerly, R. I.

EXECUTIVE COMMITTEE.

GEORGE T. MATHEWSON, *Chairman*, Thompsonville, Conn.

W. H. BOARDMAN, Central Falls, R. I.

E. A. BIRGE, Madison, Wis.

J. J. STRANAHAN, Bullochville, Ga.

DWIGHT LYDELL, Mill Creek, Mich.

TARLETON H. BEAN, at World's Fair, St. Louis, Mo.

INDEX.

PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, August 5, 1902.

Convention called to order at 2:30 p. m., by the Recording Secretary, Mr. George F. Peabody, and on motion duly made and seconded, Mr. F. B. Dickerson, of Detroit, was elected temporary chairman, in the absence of President Bryant.

The registered attendance at the meetings of the Society is as follows:

Bean, Hon. Tarleton H., at World's Fair, St. Louis, Mo.
Birge, E. A., Madison, Wis.
Boardman, William H., Central Falls, R. I.
Booth, Dewitt C., Spearfish, S. D.
Bowers, George M., United States Fish Commissioner.
Brewster, C. E., Grand Rapids, Mich.
Brown, G. W. M., Saginaw, Mich.
Bryant, E. E., President, Madison, Wis.
Clark, F. N., Detroit, Mich.
Cole, Leon J., Ann Arbor, Mich.
Coulter, A. L., Michigan.
Dean, H. D., Neosho, Mo.
Dickerson, F. B., Detroit, Mich.
Downing, S. W., Put-in-Bay, Ohio.
Filkins, B. G., Northville, Mich.
Fox, J. C., Put-in-Bay, O.
Geer, E. Hart, Hadlyme, Conn.
Green, Dr. Duff W., Dayton, O.
Gunckel, J. E., Toledo, Ohio.
Hogan, J. J., Wisconsin.
Lane, George F., Silver Lake, Mass.
Lydell, Dwight, Mill Creek, Mich.
Marsh, M. C., Washington, D. C.
Mathewson, G. T., Enfield, Conn.

Morris, E. H., Washington, D. C.
Morton, William P., Providence, R. I.
Palmer, W. A., Buchanan, Mich.
Peabody, George F., Appleton, Wis.
Pike, R. G., Middleton, Conn.
Plumb, C. H., Mill Creek, Mich.
Reighard, Jacob, Ann Arbor, Mich.
Roberts, A. D., Woonsocket, R. I.
Root, Henry T., Providence, R. I.
Seagle, George A., Wytheville, Va.
Stranahan, F. A., Cleveland, Ohio.
Stranahan, J. J., Georgia.
Titcomb, J. W., Vermont.
Ward, Henry B., Lincoln, Neb.
Willard, C. W., Westerly, R. I.
Wires, S. T., Duluth, Minn.
White, R. Tyson, Brooklyn, N. Y.
Wollett, W. H., Put-in-Bay, O.

During the several sessions the following gentlemen were elected to membership in the Society:

Allen, A. D., Flora, Ore.
Ashford, W. T., Atlanta, Ga.
Bean, Tarleton H., St. Louis, Mo.
Benton, Judge Henry T., Scale, Ala.
Booth, DeWitt C., Spearfish, South Dak.
Boudre, N. H., Plummerville, Ark.
Brown, George H., Jr., Washington, D. C.
Burham, E. K., Northville, Mich.
Carter, E. N., St. Johnsbury, Vt.
Cole, Leon J., Ann Arbor, Mich.
Dublee, J. Clyde, Williamsport, Penn.
Evarding & Farrell, Messrs., Portland, Ore.
Everman, Prof. Barton W., Washington, D. C.
Gebhardt, A. E., Salem, Ore.
Geer, Dr. E. F., St. Paul, Minn.
LeGettee, K., Centenary, S. C.
Green, Dr. D. W., Dayton, O.
Hampton, F. T., Hill City, Tenn.

Henkel, C. P., Neosho, Mo.
Hogue, William F., Marion, Ala.
Howell, John H., Auburn, N. Y.
Johnson, D. W., Hartwell, Ga.
Joslin, Hon. C. D., Detroit, Mich.
Kendall, Dr. William C., Washington, D. C.
Kennedy, Edwin M., McConnellsville, O.
Landers, E. T., Hopeville, Ga.
Lewis, Charles E., Minneapolis, Minn.
Miller, Frank, Put-in-Bay, O.
Monroe, Otis, Mill Creek, Mich.
Moody, G. C., Mill Creek, Mich.
Mullett, R. M., Washington, D. C.
North, Paul, Cleveland, O.
Palmer, W. A., Buchanan, Mich.
Paxton, Thomas B., Cincinnati, O.
Pearce, Caption T. C., Washington, D. C.
Plumb, Charles, Mill Creek, Mich.
Prendergast, Charles F., Savannah, Ga.
Rodgers, J. L., Columbus, O.
Saunders, Dr. H. G., Chattanooga, Tenn.
Simons, Max, Columbus, Ga.
Thomas, Henry G., Stowe, Vt.
VanDusen, Hon. H. G., Astoria, Ore.

Corresponding Membership:

Feilding, J. B., Holywell, North Wales.

Mr. F. B. Dickerson took the chair.

Mr. Dickerson: If there is any one thing that predominates more than another in the American Fisheries Society, it is speed and rapid work, and it is therefore suggested that we proceed with the election of new members during the absence of the president, in order that there may be no delays, and that we can begin work as soon as he arrives. It is proposed to elect these men who desire to become members, at the very outset, and justly so, in order that they may participate in our proceedings. If, therefore, any of you have any new members to suggest, will you kindly present them at once.

We have received the following letter from the Board of Game and Fish Commissioners of the state of Minnesota:

STATE OF MINNESOTA.
Board of Game and Fish Commissioners.
St. Paul, August 2nd, 1902.

Mr. George F. Peabody, Sec.,
American Fisheries Society,
Put-in-Bay, O.

Dear Sir:—

This will introduce to you Dr. Ethelbert F. Greer, who takes a big interest in everything pertaining to fish and fish culture. He wishes to become a member of the American Fisheries Society and is leaving our city to attend the meeting. If consistent, I would like him to represent our Minnesota Game and Fish Commission and anything you can do to make it pleasant for the doctor will be very much appreciated. Yours very truly,

SAM. F. FULLERTON,
Executive Agent.

I desire to propose the doctor as a member of this association. He happened to fall in with the Philistines coming down from Detroit this morning, but did not suffer any serious and lasting damage from the encounter.

(Laughter and suggestion that the suffering may come later).

Candidates for membership were then proposed and elected, whose names together with those of all others elected during the several sessions of the society appear at the beginning of the printed proceedings. President E. E. Bryant then took the chair.

President Bryant: I give you greeting and assure you of my great satisfaction in seeing so many faces that have grown familiar and dear to me, as engaged in this work. I congratulate you upon your safe arrival here, and I think in selecting the place for our meeting, the good committee who made this selection and recommended it to our society, builded better than they knew; for certainly it is a charming spot; and one good thing about it is that it is going to be a little difficult for us to get away until our meeting is over. (Laughter).

We have everything to cheer us on in this work. It is less than half a century since the feasibility of the idea of increasing the productivity of the waters was brought to the notice of men: and the result that has been accomplished in that half century is something marvelous, and the progress of the work and the results being achieved by the states and by the United States and by the enterprising gentlemen who are entering upon this work to produce fish for the market, are something to give us especial gratification.

Another feature of the subject commends itself to our satisfaction and that is the universal confidence that is expressed by the public in our work. I see that year by year, not only as a local observation, but as manifested by the generous efforts of the legislatures of the states and by congress in forwarding and aiding the work in which we are engaged.

I hope our meeting will be as pleasant, as satisfactory, as profitable and instructive to us all as the meetings we have had in the past. Indeed, in my own experience, I may say that each meeting adds to my stock of knowledge; it increases my interest and opens up new fields of inquiry, and with the intelligent work that is being done in the direction of the propagation of fish there is surely success to be achieved. We have yet our problems and our difficulties, but one by one they are being surmounted, although there are many conditions yet to be realized to achieve all that can be accomplished. Our laws for the protection of fish are yet imperfect, public sentiment in enforcing those laws is yet feeble, and we must build up along those lines; we must not only fill the lakes and the rivers with small fish to grow to maturity, but we must so protect them that the greatest ultimate good may be achieved, and that this end may not be thwarted by wanton or lawless invasion—or too weak and feeble laws for the protection of the fish, which we have demonstrated to the world in our various fields we can produce in unlimited quantity to supply all the wants of men. We must get the laws and organized societies to join with us in securing for the public the greatest benefit that can be accomplished.

I am requested by the United States Fish Commission to give you the grand totals of their work for the year. You recollect their report last year showed an extraordinary growth and increase in their output. So far as I have been able to examine the state reports, everywhere there is evidence of increased success, larger output, broader and more generous distribution; and the figures which will appear in the United States report soon to be published for the fiscal year ending June 30th, 1902, will show a very gratifying increase in the beneficient results of the work of the United States Fish Commission, in every line of productivity; and I am pleased to notice that whenever we write to congressmen, in behalf of the commission, to aid us, or to be helpful along the lines of supporting the United States Fish Commission, and indirectly the other commissions, they invariably reply that they are heart and soul with the fish commission and wish to render it every aid possible. We have a grand total here of a billion and a half distribution of fish during the last year, while for the previous year it was a little over a billion. This increase is shown in nearly all the lines of production, a very gratifying result, and one that gives us all encouragement to go on.

The report furnished me is as follows:

SUMMARY OF DISTRIBUTION,

1902.

TOTAL	EGGS	Fry and Fingerling	Adult and Yearling	TOTAL
Shad	....	104,986,000	2,000,000	106.986,000
Quinnat Salmon	19,346,410	29,337,308	....	48,683,718
Atlantic Salmon	300,000	56,765	282,000	638,765
Landlocked Salmon	200,000	523,655	98,565	822.220
Silver Salmon	....	424,530	....	424,536
Blueback Salmon	....	3,371.000	....	3,371,000
Steelhead Trout	68,000	389,196	77,686	534,882
Loch Leven Trout	....	91,760	5,000	96,760
Rainbow Trout	397,790	784,835	492.496	1,675,121
Blackspotted Trout	280,000	100,600	1,488,500	1,868,500
Brook Trout	920,000	5.222,422	437,340	6.579,762
Lake Trout	5,235,000	22.022.478	3,012	27,260,490
Scotch Sea Trout	10,000	7,694	6,837	24.531
Golden Trout	....	69,950	....	69,950
Grayling	655,000	1.130,333	17,925	1,803,258
Whitefish	111,260,000	483,230,000	....	594,490,000
Pike Perch	60,000,000	177,099,000	....	237,099,000
Catfish	....	....	95,970	95,970
Pike	....	....	575	575
Pickerel	....	....	805	805
Ring Perch	....	....	1,700	1,700
Buffalo	....	....	200,000	200,000
Black Bass	....	....	262,157	262,157
Crappie	....	....	735,120	735,120
Rock Bass	....	....	37,170	37,170
Strawberry Bass	....	....	3,351	3,351
Warmouth Bass	....	....	100	100
Calico Bass	....	....	200	200
Sunfish	....	....	606,040	606,040
Bream	....	....	17,699	17,699
Cod	....	212,001,000	....	212,001 000
Flatfish	....	168,133,000	....	168,133,000
Lobster	....	81,020,000	....	81,020,000
Totals and Grand Total	198.672,200	1.290.000,926	6.870,248	1,495.543.374

I should be very glad if we had a brief presentment to show what had been accomplished by the various states. I can only say in general terms that they are all making good gains and advances. With these somewhat hasty remarks, gentlemen, I will not detain you longer from the business which we are met here to transact.

Motion was then made that a committee on nominations of officers, and a committee on time and place of meeting be appointed by the chair.

Motion seconded and carried.

Mr. F. B. Dickerson offered the following resolution:

Whereas, The American Fisheries Society has on several occasions expressed its approval of the plan to establish a biological station on the Great Lakes in the interest of the fisheries, and

Whereas, A measure now pending before congress provides for the inauguration of such an enterprise, therefore be it

Resolved, That a committee of five be appointed from the society to urge the importance of the matter on members of congress and to further the plan in every legitimate way.

The President: I understand an appropriation has already been made for this purpose.

Mr. Dickerson: No. I understand the matter was brought up, and passed congress, establishing a biological station for the study of the growth and food of various salt water fish; but no such station has ever been established on the lakes for the study of the growth and food of the fresh water fish, which is a matter of great importance to the middle states. This matter was brought up in congress but failed to pass both houses, owing to a press of other business.

The President: It probably will be reached in the next session.

Mr. Dickerson: Yes, the matter simply died in committee.

Dr. E. A. Birge, of Wisconsin: Is it dead?

Mr. Dickerson: It passed one body or the other.

Dr. Birge: It was contained in an omnibus bill of the house.

Mr. Dickerson: Yes, but it did not pass both houses on account of lack of attention. My suggestion is that the president appoint a committee to watch that thing and push it at all stages of the game at the next congress. If we had done that before we would have passed it at this last congress.

Motion made, seconded and unanimously carried, adopting the resolution.

Mr. Dickerson: I want to apologize for doing three days' work in one, because I expect to have to leave tonight or at 5 o'clock tomorrow morning, owing to business matters at home requiring my attention.

It seems to me there is one matter which this association has always neglected and that is the matter of creating a public sentiment in favor of fish culture. We began in Michigan a year and a half ago in a systematic way to educate our people in the state in the interest of fish culture; we have already profited by it; it is a matter that has never been discussed by this association, a matter that has never been taken up, and we ought to devise some way of systematicially educating the public in favor of fish culture. Every state where fish culture is carried on to any extent needs attention in that direction. When a farmer comes to the legislature, if fishing in his immediate vicinity is of no great importance, he looks on raising little fish as child's play; he votes against the appropriation because he does not see any need for the work in his own neighborhood; he takes no interest in the matter. The opposition in our legislature comes from those gentlemen who live in districts where there is no water in their immediate vicinity and where they derive no direct benefit near their homes from an appropriation in the interests of fish culture; and for that reason, to properly conduct the work (and we cannot conduct it properly unless we get sufficient appropriations with which to conduct it) it is necessary, in my judgment, to begin in asystematic manner to make public sentiment in the interests of fish culture; and I want to suggest that that matter be discussed here so far as it possibly can, and I will offer a motion that the chair appoint a committee to recommend at our next meeting the best method or methods of interesting the public and creating public sentiment in favor of fish culture.

Motion seconded.

Mr. George F. Peabody, of Appleton, Wis.: I think Mr. Dickerson's idea is a very excellent one, but still the initiative must be taken by the state fish commissions in their work in each state. They are the men to educate the public, and they can only do it by intelligent work, each commission in its own state. Now, Michigan stands in the front rank, and I am proud to say that Wisconsin is a close second (modestly, I say, a close second) and the state of Wisconsin is educated to this point; and people send for fry, as General Bryant knows, from all over the state. Farmers want them and are generally friendly to the work of the commission in the state of Wisconsin; and each year, as the president indicated in his opening address, there is more and more to encourage the work of this society. Now, it seems to me that this society cannot do this work exactly as Mr. Dickerson suggests; it is a very excellent idea to bring it up, however, and have it discussed. But it is the business of each state commission to undertake this task. How many states have we represented here? Just a handful! Here is the great state of Ohio. How many Ohio men are there here, although the meeting is held right in its own waters?

Mr. Dickerson: They have no water in Ohio.

Mr. Peabody: They have lots of it around here, yet they are not represented. Massachusetts has one representative here, Vermont none, New Hampshire none, and the great state of Maine none. Those are the people to do this work. This society can merely discuss these matters and make investigations and promote an interest through its members, but the fish commissions of each state are themselves to blame in this matter, if they lie down and stay away from these meetings and take no interest in them. I do not think it is the province of this society to chase them up very much.

It seems to me that the scope of this society is to go on as it is doing in original investigation and in discussion of methods of propagating fish and all that sort of thing. It is throwing a brilliant light on the subject of fish culture, each year more widespread. This season, as secretary of the society, I have had applications from foreign countries and from all over the United States, and from men whom you would think were not interested especially in this work, for the printed transactions of the society, and that indicates that the interest is growing and is widespread. I think the thing to do is to get at the state fish commissions, get at the governors and have them appoint commissions like the fish commissions of Wisconsin and Michigan, Rhode Island and other states which are enthusiastic and interested and will promote education as suggested in the resolution.

Mr. Dickerson: I agree exactly with Mr. Peabody. We in Michigan have known that you have more sentiment in favor of fish culture in Wisconsin than we have had in Michigan, until within the last eighteen months. Now, Mr. Peabody has made an excellent argument for my motion. I am sure that the gentlemen from Connecticut, Ohio and from every other state, would like to know in what manner and how you builded that sentiment in Wisconsin. If you have made that sentiment in Wisconsin how did you make it? We in Michigan want to know; I am sure my Connecticut friends want to know, and Ohio wants to know. Now, my suggestion is that you appoint a committee to see if the methods successfully used in one state to build up this sentiment cannot be used in another. You let a genius connected with any of the great railroad systems devise some scheme in California for the benefit of that railroad system, and it is immediately put in operation, and every office on the entire line of that system is made to feel it. Now, if the genius of somebody has builded a sentiment in Wisconsin that helps the work in that state, why should not every other state receive the benefit of his ability.

Mr. John E. Gunckel, Toledo, O.: My friend Mr. Dickerson had in mind only Ohio, when he made the motion and the able argument in favor of something that I think ought to be done. He knew very well that for the last fifteen years I have been about the only representative from Ohio at these meetings. I am not a fish commissioner, I know nothing about the hard work that my friend Mr. Clark does, but I was originally acquainted with the man who first introduced the propagation of fish, the late Judge Potter. As long as our companions and associates are all right, that makes a man solid and square. Ohio has done nothing for a number of years; but from the information that I gleaned during the last fifteen or twenty years by attending these meetings, I went home and in my back yard I tried a new plan, the culture of the fish tree, in which I have been quite successful.

I am glad to say that I have been able to supply northwestern Ohio. Since Mr. Stranahan left Put-in-Bay, something had to be done. We used to snake our fish from Stranahan, but now we get nothing! I strongly favor a committee to be appointed to wake up Ohio and other states similarly situated.

The fish commission amounts to nothing, (I do not wish the stenographer to miss that either) because it is merely a political plan from beginning to end, and you must do so and so or it don't go. Now, if there is some influence brought to bear that will lift this state out of the hole or rut into which it has fallen, it will be a blessing, and this committee can certainly lay plans as to how it shall be done. If they cannot get the fish commissioner to do something, they can back up the people; and the people are ready at any time. There never was a time in the history of the state of Ohio when the laws were so good for the protection of fish as this year, there is no question about that. All that Ohio needs is a few good men right behind it, men of experience and men that have been educated in the American Fisheries society, that will push Ohio to the front. I am strongly in favor of Mr. Dickerson's motion.

The President: The chair is inclined to commend your energy in increasing the number of fish in Ohio by introducing the new method of raising them on trees.

Mr. Gunckel: I had to do it, and then they called me a liar. (Laughter and applause). So I started to raise boneless fish, and I have succeeded, I am happy to say, in that also.

The President: I would inquire of Mr. Dickerson what is his precise motion.

Mr. Dickerson: My motion was that a committee of three be appointed to suggest to the various state commissions, or to report at our next meeting, the best method of creating public sentiment in the various states in the interests of fish culture.

Motion seconded and unanimously carried.

Mr. John W. Titcomb, of Washington, D. C.: I move that we adjourn at 5 o'clock for the afternoon session. My object in making that motion is simply to ascertain whether the members would like to take a boat ride, and if so that motion might be made conditional on the weather. The fish commission steamer

Shearwater will take those who wish to go on a little ride around the lake.

Motion seconded and carried.

Mr. Peabody: Prof. Jacob Reighard has a lecture to deliver tonight, or at any time when it is convenient for the society, illustrated by the stereopticon, and it might be well to consider that matter before the adjournment.

Prof. Reighard: The only point about this is, that if this lecture is to be given with the lantern it will be necessary to make arrangements with the electricians for the connections, so that I will have to know in advance when it is to be given.

Mr. Titcomb: I move that the lecture be given here tonight at 8:30 o'clock, if agreeable to Prof. Reighard, and that the public be invited to attend.

Motion seconded and unanimously carried.

Prof. Henry B. Ward, of Lincoln, Nebraska, then read a paper by Dr. R. H. Pond, of Michigan, on the subject, "The Role of the Larger Aquatic Plants in the Biology of Fresh Water."

The president appointed as a committee on program, Mr. Titcomb, of Vermont, Mr. Peabody, of Wisconsin, Mr. Root, of Rhode Island, Mr. Fox, of Ohio, and Mr. Pike, of Connecticut.

Mr. Clark: I think we should now hear the secretary's report.

Secretary Peabody: The printed transactions constitute the secretary's report. Aside from that I have no other report than that which I have read. The printed report of the discussions has been sent to all the members and to applicants for membership. The work of the secretary is embodied in that report, and as far as finances are concerned, is contained in the treasurer's report.

The treasurer's report was then presented as follows:

Westerly, R. I., Aug. 5th, 1902.

To the American Fisheries Society:

Gentlemen:—

I beg to submit herewith my annual report as treasurer from July 18th, 1901, to August 5th, 1902.

RECEIPTS.

Balance in treasury	$165.09	
Yearly dues and fees	228.00	
Six copies of reports sold	1.50	
Interest on deposit in bank	2.85	$397.44

EXPENDITURES.

1901.			
July 20.	J. W. Titcomb, sundries at Milwaukee	$ 9.50	
Aug. 3.	S. Bower, Sec., sundries at Milwaukee	5.80	
Aug. 3.	Stamps and envelopes	7.74	
Aug. 10.	H. D. Goodwin, stenographer, by Sec	82.00	
Aug. 21.	Express on papers	.25	
Aug. 21.	Receipt book	2.87	
Dec. 10.	Post Publishing Co., by Sec	138.00	
Dec. 10.	R. B. Hoyler & Co	2.95	
Dec. 10.	Geo. F. Peabody, Sec., sundries	20.04	
1902.			
Jan. 1.	100 stamped envelopes and receipts	2.42	
May 25.	100 stamped envelopes and receipts	2.52	
July 1.	100 stamped envelopes and receipts	2.12	
July 25.	Ryan & Co., Appleton, Wis., by Sec	10.25	
July 25.	Geo. F. Peabody, Sec., stamps, etc	9.84	
		$296.30	
Balance cash on hand		101.14	$397.44

Depository of funds, Manufacturers Trust Company, Providence, R. I.

C. W. WILLARD,
Treasurer.

Mr. Willard:—I should like to have the report referred to an auditing committee.

The President: I will appoint such committee at the request of the treasurer.

On hearing the report of our good treasurer and noticing that he accounts for interest on deposit, reminds me that it was told historically, I believe, that the great William Pitt when he was made paymaster of the forces, the general understanding being that he was to have the interest on deposits as part of the perquisites of his office, with stern honesty accounted for every cent of the interest as well as principal; and a great many people of England thought that he was foolish to do it. The great Edmund Burke, also made paymaster of the forces for the purpose of enriching his purse, was so strictly honest that he accounted for the interest on the deposits; and I am glad to find that our good treasurer, with the same sense of fidelity and loyalty to our fund, has accounted for the interest, and deserves especial commendation for his frugality and financial wisdom in investing our funds so that they yield an income.

Mr. Peabody: A large number of letters of regret have been presented, also excuses for not furnishing papers, and I suppose it is unnecessary to read them all, but there is one from Mr. E. W. Blatchford to which I should like to refer. A great many of you remember him at Wood's Hole. He was very much interested in the matter of a monument to Prof. Baird; and the latter part of his letter is of interest as pertaining to that subject. He says:

"The 'Baird Memorial Committee' are engaged in preparation for the dedication of the admirable granite boulder and tablet in Prof. George Baird's memory—the large and thoughtful work connected with which has been done by our honored chairman—Dr. Smith."

Mr. Gunckel: I may be fishing in water where I cannot land the fish, but at least I can cut bait. I would respectfully suggest a change in the constitution and by-laws as follows: Make present Article 5, Article 6, and then add Article 5 which shall read as follows:

"Order of business shall be as follows:"

(You all notice the trouble that we have in the order of business).

"First: Call to order by the president.

"Second: Roll call of members.

"Third: Application and action on new members.

"Fourth: Reports of officers, president, secretary and standing committees.

"Fifth: Appointing committee of five to nominate officers for ensuing year.

"Sixth: Appointing committee of three on time and place for next meeting.

"Seventh: Appointing auditing committee of three.

"Eighth: Reading of papers and discussions on same.

"N. B.—Preference to reading papers shall be given to members present, and in order of notices received by the secretary.

(I did not prepare a paper this time, because I thought as you met in Ohio, it would be a matter of respect to the other states that Ohio should give way to the distinguished gentlemen from abroad. A man who comes 500 miles to attend our meetings and has given notice that he is going to read his paper, should be entitled to first attention and a full house).

"Ninth: Payment of annual dues."

I respectfully submit this for your consideration, and only suggest it because I think it may be something that will lead us to firmer ground.

Mr. Peabody: I move that this matter be referred to a committee of three.

Motion seconded and carried.

Mr. Clark: I move that the secretary be instructed, if necessary, to mail a copy of the present printed report to all new members.

Motion seconded and unanimously carried.

Secretary Peabody: I have sent them to all of the members that we have received during the year, and there are enough to go around now.

Mr. Titcomb: I would say in connection with this that a resolution was passed at the meeting at Wood's Hole, providing for the sale of back copies of the transactions, so far as available, to those wishing to complete their files. I simply call attention to the matter.

Dr. Reighard: Are there complete sets?

Secretary Peabody: No, there are no complete sets.

Mr. Frank N. Clark, of Michigan, then presented a paper on the subject, "A Successful Year in the Artificial Propagation of the Whitefish."

The president appointed as committee on nominations and selection of place of meeting: F. N. Clark, of the United States Fish Commission, Dwight Lydell, of Michigan, J. J. Hogan, of Wisconsin, G. T. Mathewson, of Connecticut, and H. B. Ward, of Nebraska.

As committee to urge upon congress the importance of establishing a biological station on the great lakes, F. B. Dickerson, of Michigan, Jacob Reighard, of Michigan, E. A. Birge, of Wisconsin, J. E. Gunckel, of Ohio, R. T. White, of New York.

Prof. Reighard: Arrangements have been made for the reading of my paper accompanied with stereopticon views, in a large assembly room of the hotel, at 8:30 o'clock tonight.

While I am on my feet I wish to present to the society Mr. Dickerson's excuses for leaving, but pressing private business required him to return home this afternoon.

Adjourned to 8:30 p. m., same day and place.

EVENING SESSION, 8:30 O'CLOCK.

Meeting called to order by the president.

The President: You all probably know that our appointment this evening to hear the lecture of Dr. Reighard failed because of lack of electric current to operate the lamp to be used, and so we have concluded to spend the evening in the regular business of the society, taking up the reading of papers and receiving reports of committees.

The chairman of the program committee then presented the following report: The committee on program were unanimously decided that the day's session should begin at 9:30 a. m. and last until 12, and begin in the afternoon at 2:30 and last until 5; that the papers of those who were present should be read in preference to the papers of those who are not here to read them personally; and the idea was that the bass papers should be grouped and all read at one session. The plan was to have the bass papers in the morning, and talking with the committees separately about this meeting tonight, it was thought that if the members present desire to continue, the trout papers might best be taken up tonight, one by Mr. Seagle and one by Mr. Marsh. Tomorrow afternoon after the session, if the members desired, there could be another trip on the Shearwater, which in fact is at the disposal of the members at any time.

Report of committee unanimously adopted and committee discharged.

Mr. M. C. Marsh then read a paper on the subject of "The Brook Trout Disease and Cement Ponds."

Mr. George A. Seagle, of Virginia, then read a paper on the subject, "Some Remarks on the Rainbow Trout, the Time for Planting, etc."

Mr. J. J. Stranahan, of Georgia, then presented a paper on the subject, "Fish Culture on the Farm."

(Read by Mr. Titcomb).

Adjourned to 9:30 a. m., Wednesday, August 6th, 1902, same place.

Wednesday, August 6, 1902.

MORNING SESSION, 9:30 O'CLOCK.

Convention called to order by the president.

The president appointed as a committee on proposed amendment to the constitution, Mr. Gunckel, of Ohio, Mr. Pike, of Connecticut and Mr. Stranahan, of Georgia.

Dr. Bean: I would like to extend an invitation to the members of the American Fisheries Society to consider the advisability of holding the meeting in 1904, at St. Louis, at the time of the exposition. I am well aware that the last meeting of the American Fisheries Society held in Chicago in 1893, was not in every respect as satisfactory as it might have been, for reasons with which doubtless many of you are entirely familiar. There was strife at that time; there is none now. In the year 1904 the United States government will, I have no doubt, make the finest display both in fisheries and fish culture which it has ever made, and there is a perfect understanding between the authorities of the exposition and the authorities of the United States Fish Commission, so that both will work harmoniously, intelligently and enthusiastically, with the object of bringing together not only interesting displays, but discussions of fish culture and fishery subjects. I suppose this meeting would be held at a time of the year which would be agreed upon by the society.

St. Louis has the reputation of being a very hot city in summer. I have spent the present summer there, and it is the first summer I have spent in any city in twenty-five years, and I have suffered far less than I have in Washington at the same time of the year. It is a cool year, I know, but 1904 may be another cool year. In ordinary years the temperature of St. Louis is much more endurable than that of a great many of the eastern cities. I have lived in New York for a good many years and am a resident of New York now, and when I say that St. Louis has treated me more kindly in the matter of comfort than New York City, you may be surprised, but it is nevertheless true.

In St. Louis, as I said, the government will have a very large display of live fish and of fishery appliances, and in addition to that the foreign governments will come in and show what they can do in the way of fish culture and oyster culture. While, of course, in some respects we have very little to learn from the foreigners, yet in other respects, especially in oyster culture and in the handling of lobsters and other crustaceans, we have a great deal to learn from the Europeans—and they will be there. Their space is already engaged, and we shall have their representative men in fish culture as well as in fishery.

Now, St. Louis is one of the most important places in the west, not only as a fish market, but as a city in which fishing interests are enthusiastically considered. I believe that I have never found a city of its size which contained so many intelligent fishermen. It is a singular thing that the state does not reflect the sentiment of St. Louis. I suppose it is because the state officers, the commission, may be politicians—that I don't know. I am not interested at all in politics, but I have found that whenever a commission does run into politics there is very little work done except that which will serve the politician's purpose, and I can account for it only in that way. Aside from that, St. Louis is really a remarkable place as a fish center, that is to say, a market for fresh and preserved fish, as a place from which anglers go out to catch fish and study fish. Therefore, gentlemen, I hope that you will look over this matter favorably and decide next year to hold your meeting in St. Louis. You will be very welcome and the exposition authorities will do everything in their power to make you comfortable and happy.

The secretary then presented the following letters:

St. Louis, Mo., July 24th, 1902.

Mr. J. E. Gunckel, Corresponding Secretary,
The American Fisheries Society,
Toledo, O.

Dear Mr. Gunckel:—

I have seen the announcement of the meeting of the American Fisheries Society to be held at Put-in-Bay, August 5th to 7th. I wish I could be with you, and possibly I may be there. I am writing you now to ask your co-operation in securing a meeting of the society at the Exposition in St. Louis in 1904. Of course it is a little early to pass a resolution on this subject, but not too early to agree informally, at least, to such a course. You know that meetings of fishery societies at international expositions have always been extremely interesting. The Exposition authorities will welcome you, and you will be provided with a suitable place in which to hold sessions.

Will your state do anything about a fish exhibit at St. Louis? I am sending you, herewith enclosed, some copies of the first circular of the Fish and Game Department. I also have charge of the Forestry Department as Acting Chief. Kindly write to me as soon as convenient and let me have your assurance of sympathy and co-operation.

Very truly yours,
TARLETON H. BEAN.

THE FISHING GAZETTE.

G. E. Jennings, Publisher and Proprietor.

203 Broadway,
New York, August 4th, 1902.

Mr. George F. Peabody,
Secretary of the American Fisheries Society,
Hotel Victory, Put-in-Bay, Ohio.

My Dear Mr. Peabody:—

I regret exceedingly that I cannot be with you, for owing to sickness, etc., I find it necessary to remain in New York during the month of August. I am, of course, greatly disappointed, for I had anticipated a pleasant outing with you all on Lake Erie. However, I shall have to postpone my meeting with you until next year, when I hope the meeting will be held in an eastern city.

I returned from Halifax on Friday and stopped at Boston on my way and called upon Capt. J. W. Collins, Chairman of the Commissioners of Fish and Game of Massachusetts, who was at one time a member of the society. I suggested that it would be a graceful act to invite the society to hold their next meeting in Boston, but Captain Collins very modestly said that he was not in a position to do so, but I feel sure that if Boston should be chosen the members from that city, particularly John R. Neal, who is one of the most prominent fish merchants in the United States, and Mr. Jay Smith and I think also Captain J. W. Collins, would be only too willing to make it pleasant for the members. I feel quite sure that if the meeting should be held in that city, I could get a number of prominent business men interested in the society and enlarge the list by a number of new names.

This, of course, is all subject to the committee on location—merely a suggestion. Boston is well located for an outing for the western members, who are fond of the sea and its products, and convenient to a number of well known seaside resorts, and I think it would be well to consider having the meeting there next year.

Trusting the present meeting will be a big success and wishing to be kindly remembered to all, I remain,

Yours truly,

G. E. JENNINGS.

Mr. Titcomb: I do not think it is wise to begin the discussion of papers on black bass until more members are present, and I do not like to appear on the floor too often, but as a little tribute to the scientists of the commission I want to read a little squib which I see comes from the London Chronicle:

THE LOBSTER HATCHERY.

Nature grim, in remorseless mood,
Undoes the work that she has done,
And out of every lobster brood
Slays ninety-nine and keeps but one.

Art stretches o'er the horrid scene
Her skillful and remedial sway—
And when I speak of "Art" I mean
The Fish Commission, U. S. A.

It takes the tender lobsterlet,
And gives him food and kind advice,
Changes his boots if they are wet,
Brushes his hair and makes him nice.

And lo, this baby of the sea
In gratitude begins to thrive;
Where one per cent it used to be,
Fifty, all fat, remain alive.

O noble work, heroic, grand,
That saves in scientific ways
Those little lisping lobsters, and
Keeps them for me and mayonnaise.

Mr. Gunckel: The committee on amendment of constitution and by-laws is ready to report.

The President: We will hear their report.

The report was then read by the secretary as follows:

AMENDMENT TO CONSTITUTION AND BY-LAWS.

New Article: Order of Business.
Instead of present Article No. V.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by the president.
2. Roll call of members.
3. Application of new members.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Standing Committees.
5. Committees appointed by the president.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—In the reading of the papers preference shall be given to members present and in the order of notices received by the secretary).

7. Adjournment.

Dr. Birge: I move the adoption of the committee's report.

Motion seconded.

Dr. Birge: I should like to ask a question. This is a substitute for Article V?

Mr. Gunckel: Article V becomes Article VI. I thought that the secretary would understand that. Article V is an amendment to the constitution.

Dr. Birge: May I ask in what way the constitution can be amended?

Mr. Gunckel: At any time by a vote of two-thirds of those present, provided fifteen are present.

Dr. Birge: My own feeling is that unless it is very easy to get away from it, it is not advisable to tie ourselves up to an order of business from which we cannot depart pretty readily. I notice, for instance, one thing in this proposed amendment which I feel sure the society will want to change quite frequently, and that is, that the papers are to be read in the order in which notification is received by the secretary. Certainly if we have a group of papers on a given subject, as we had last night on the trout, and are expecting to have today on the black bass, I suppose it would be frequently, at least, the wish of the society that the papers connected in subject should be read together, rather than scattered around and sandwiched in with papers that have no relation to them.

Mr. Titcomb: I concur with Prof. Birge on that part of this amendment. It seems to me that the order of the reading of the paper should be decided by either a committee or the officers who have charge of the meeting, and if this rule is adhered to we would not have our papers grouped in the order they ought to come. For illustration, today, by your committee on program, it was suggested that we take all of the day's papers at one session, and very frequently a man comes a long distance and is interested in bass, or is interested in trout. Now, he would like to hear everything on that one subject during one session; he may have to go away. I think further while talking on this subject, though it may not be entirely about that resolution, that we ought to have a committee to whom all papers should be submitted, and let them decide whether those papers are all to be read. We may have some paper that we do not want published by the American Fisheries Society. Some crank may read a paper which does not do the society credit. We might get some stuff into our pamphlets that would not do us credit when sent broadcast through the world as our pamphlets are; and a committee could look them over and be a sort of a censor body perhaps. I object to that clause. I think if that note was simply omitted, then we can suspend rules any time to carry out Prof. Birge's idea, and we would not be tied up in that particular part of it. I think we ought to have an order of business.

The President: The sixth order of business is reading of papers and discussion of same, and to this is appended a note as follows: "In the reading of papers preference shall be given to members present and in the order of notices received by the secretary." The suggestion is that the note be stricken out.

Mr. Gunckel: If you will allow me, of course it is generally known that if I can slip in a paper occassionally it doesn't amount to anything—I admit that—but being in the position that I am and not of a scientific nature, except what I can glean from these meetings, I would say that this suggestion does not come originally from me, but from a great many members present who read papers nearly every time. You have twice, I think, carried motions, to the effect that gentlemen who are present shall have the preference of reading their papers over those who are absent; and this is the first time since I have attended any of the meetings where you have divided papers off into groups. That, of course, would naturally change the preference that I have inserted there, but certainly a man who has come 400 or 500 miles and whose time is limited ought to have the preference in reading his paper over one who is not present, but who has sent his paper in, thus perhaps delaying the paper of a man who is present until too late to read or discuss it. It is unfair. That is the argument, and I strongly think that that note of preference there should be given to the writers of papers who are present. You can divide the papers up into groups or in any way you wish, but the men who are present certainly should have the preference.

Then again, if I get up at 5 o'clock in the mornings and study for a whole month and prepare a scientific article and I come here to read it and want to discuss the subject, I am certainly entitled to the presence of a majority of the members. Some of you members have spent a lifetime in propagating fish and learning the secrets of their movements and everything, and it is not fair to a man who comes a great distance to be put back to the last in favor of some one who has sent in his paper late.

Dr. Birge: I think you misunderstand my point and that of Mr. Titcomb. The thing I objected to was in regard to the papers being read in the order of notices received by the secretary. I am ready to agree that the members present should have the preference in the matter of reading papers; that is the ordinary custom in societies; but I should strike out that last part. The fact that I give notice of preparation of a paper three months ahead ought not to put my paper on the first session as against the man who sends in his notice one month ahead.

Mr. Gunckel: The man that gets up in the morning and sends in his article first pleases the secretary. The man that is late, sneaks in and hands an article to the secretary and says he has prepared it since he has been there, should not be allowed to read his paper first. I say the man who got here early should be recognized first.

Mr. Titcomb: I think, as Dr. Birge says, we are all agreed that the people who are here should have the opportunity to read their papers in preference to those presented later, but I think we ought to have some system about grouping our papers, and if we adopt the note as it now reads, we are going to get, perhaps, a paper on trout culture the first part of the session and then take up a paper on trout culture again the last part of the meeting. I think all kindred subjects should be taken up together, just as we take up the bass question this morning.

Mr. Gunckel: Then strike out the words "in the order of notices received by the secretary."

Dr. Reighard: I move to amend the report by omitting that clause which refers to the papers being read in the order of notices received by the secretary.

Motion seconded.

The President: That will leave liberty of adjustment and grouping of papers at the meeting.

Unanimously carried.

The President: The amendment to the constitution, as amended, by adding Article Five and changing the present Article Five so as to read Article Six, is now before you, as amended.

Mr. Clark: The committee are ready to report on officers and place of meeting.

The President: We will receive the report.

Prof. Ward: I should like to move that it be the rule of this society that the officers shall be empowered to group and arrange the papers for the session, constituting them practically a committee for that purpose, and enabling them to do it a little in advance of the time of the meeting. I propose that as a standing rule.

Motion seconded.

Mr. Titcomb: Do you wish to include all of the executive committee? I think if it is left to the president and secretary you will have the thing done more quickly than if you wait for all the officers to get together.

Mr. Ward: I will accept the suggestion, making it a committee of three, the president and the two secretaries.

The President: Will you state the motion again?

Prof. Ward: That the president and the two secretaries be empowered to arrange and group the papers for the programme of the meetings of the society.

Mr. Gunckel: We have had motions similar to that and we always forget them. Now, why can't you make that part of Article Five of our constitution and by-laws, right after the article we have discussed here, and then it will always appear in our report. We have no back reports here. There are a lot of motions which we have forgotten all about. There is one made in New York a few years ago, and you have forgotten all about that.

Prof. Ward: I will gladly do that if it can be adopted constitutionally. Now, I should be glad to accept the suggestion and make it Section 2 of the present article.

Mr. Gunckel: I would suggest that under Rule 6 this proposed amendment shall be noted as Section "b."

Dr. Birge: I would suggest that the words, "and group" be omitted. The power to arrange is sufficient.

Prof. Ward: I will accept the suggestion.

The proposed amendment to the constitution is that the president and the two secretaries be empowered to arrange the papers of the meetings of the society, and that that be added to Article 5 as Clause "b" of the constitution just amended.

Seconded and unanimously carried.

The amendment to the constitution as finally adopted is as follows:

AMENDMENT TO CONSTITUTION AND BY-LAWS.

New Article: Order of Business.
(Instead of present Article V.)

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of Officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—a. In the reading of papers preference shall be given to members present.
   b. The President and the two secretaries are empowered to arrange the papers of the meetings of the society).

7. Miscellaneous business.
8. Adjournment.

Mr. Clark: Without taking up too much time I will state that the committee on time and place have had under consideration the invitations from different points, very cordial ones from Niagara Falls, Buffalo, Wood's Hole and Mill Creek, Michigan. Those presenting the names of these different cities (especially Mill Creek) have invited the society very cordially. Mr. Tuttle presented the Niagara Falls matter, and they are all good places —no question about it—but the committee have decided to make the following report:

After carefully considering the invitations from the several cities, we respectfully suggest that the next annual meeting be held at Wood's Hole, Massachusetts, on Tuesday, Wednesday and Thursday of the fourth week of July, 1903, namely the 23rd, 24th and 25th of July, and that the meeting be called to order at 2 p. m. on Tuesday. It is further suggested that the place and time be printed on the letter heads usually furnished by this society.

They also wish to report as their suggestions for officers for the year:

President—George M. Bowers, Washington, D. C.

Vice President—Henry B. Ward, Lincoln, Neb.

Recording Secretary—George F. Peabody, Appleton, Wis.

Corresponding Secretary—John E. Gunckel, Toledo, O.

Treasurer—C. W. Willard, Westerly, R. I.

Mr. Peabody: I would like to say that it will be impossible for me to act next year. As I am planning now, I may be out of the country; and further, I think it was rather understood that we were to take turns at this thing, and it is quite a responsibility and quite a duty. If my memory serves me right, I think it was understood that one year's service entitles one to be retired from that position, and I will ask you to substitute some one else for that office.

Mr. Gunckel: Naturally the corresponding secretary follows suit. Of course the corresponding secretary's duties are not very laborious—a little correspondence from the east and west—but I think as that is more of an honorary position, that you ought to change and have some other person. It is not very important to me, because there is little to do, but I think you ought to follow the rule and change. Of course the committee thought it a matter of delicacy and did not like to put me out in the cold world, but I will be very glad indeed if the committee will withdraw my name and put some other person there.

Mr. Titcomb: I rise to a point of order. There is nothing before the meeting.

The President: The rule of the American Fisheries Society is, no flunking. The point of order is sustained.

Mr. Clark: I move the adoption of the report of the committee.

Motion seconded.

Mr. Clark: Mr. Peabody makes a statement that I hardly think he is warranted in making. I do not remember that at the meeting at Milwaukee anything was said about the secretary's serving but one year. I think if he goes out serving as secretary of this society only one year, that it will go to the world that this society did not think much of his work, and I for one wish to say emphatically that Mr. Peabody has made one of our best secretaries, and we have had good secretaries before him; but I really think that Mr. Peabody should reconsider what he has said. If Mr. Peabody is going to be gone the whole year, why his excuse might avail, but I hardly think that Mr. Peabody will be gone out of the United States for a whole year; I think he is too much of an American for that. He may go away to Europe for a month or two, but he will come back with renewed vigor, and can serve this society better than he has in the past, if that be possible; and I therefore hope the society will not consider his remarks.

(Voices: Question! Question!)

The report of the committee was unanimously adopted, with the exception of the vote of Mr. Gunckel, which was cast in the negative.

The President: The noes are out of order.

Mr. Gunckel: I wish to make one statement to the members. I would like to have them remember that the corresponding secretary has nothing to do with sending out the books. A great many letters come to me that should go to the recording secretary. Now, all questions on scientific subjects go to the recording secretary, all questions and problems of angling go to the recording secretary. To get truthful stories, go to the recording secretary, but if you want to learn how to lie, that matter is within the province of the corresponding secretary, and all information will be cheerfully furnished by him. (Great applause and laughter).

The President: He takes charge of the Department of the Imagination.

Mr. Gunckel: Yes, sir, I take charge of that.

Mr. Peabody: I have a letter here that one of the gentlemen from Ohio wishes me to read, as it is perhaps a defense of and an apology for the state of Ohio having no representative of and from their commission. I presume that is his purpose. There are on this letter head the names of the president and four members and two officers, but none of them is present.

STATE OF OHIO.
FISH AND GAME COMMISSION.

J. L. Rodgers, President, Columbus.

Paul North, Cleveland. Thomas S. Paxton, Cincinnati. Dr. D. W. Greene, Dayton. Edwin M. Kennedy, McConnelsville. J. C. Porterfield, Chief Warden, Columbus. George C. Blankner, Secretary, Columbus.

Columbus, Ohio, August 4th, 1902.

S. W. Downing, Supt.,
U. S. Fish Hatchery,
Put-in-Bay, Ohio.

Dear Sir:—

I had fully intended being present at the meeting of the American Fisheries Association at Put-in-Bay this week, but I find now that I am called away by an important matter and that it will be absolutely impossible for me to get back in time to attend. Please accept my thanks for your kind invitation and my sincere regrets that I cannot be present.

Wishing you a most successful meeting, I am,

Yours very truly,
J. L. RODGERS,
President.

Mr. Gunckel: That, coming from the Ohio Fish Commission, shows the first recognition the American Fisheries Society has had since 1890 from the commission, and I would make a motion that the secretary, or corresponding secretary, write officially to them, thanking them for recognizing the association, and insisting on the state of Ohio taking a greater interest in the association than it has.

Mr. Downing : I would like to correct the statement in regard to the first recognition; I think the first recognition was yesterday when I put in six dollars for the members from the Ohio Fish Commission.

The President: I think it would be well for the society to recognize that we have been hospitably entertained on the soil of Ohio, and let it go at that, and not make any record of the fact that we missed them.

The president here appointed as a committee to audit the treasurer's accounts Mr. Lane, of Massachusetts, Mr. Geer, of Connecticut, and Mr. Downing, of Ohio.

Mr. Titcomb: I wish to extend to the members of the society an invitation to attend the Rhode Island clam bake in connection with their visit to Wood's Hole next year, and the wives of the society members are also invited to partake of this clam bake. You will remember very pleasantly the clam bake we had in connection with the last meeting.

The President: I remember it very well. I can hardly wait for next year.

Mr. Clark: There was one thing in the report of the committee on place that was left out. I beg to have it put in. Mr. Dickerson, through Mr. Ward, extended a cordial invitation to this society to meet in Detroit in 1904, and he was very anxious to make this request now, so that the members could be considering it. I understand that Mr. Dickerson offers to provide a special mail train and special mail bags for each society, or something like that, and take them all over the state.

The President: Are there any further remarks on the paper read by Mr. Stranahan last night?

(No remarks).

Mr. Titcomb then read a paper by Mr. Dwight Lydell on the subject, "The Habits and Culture of the Black Bass."

Mr. Herbert D. Dean, of the United States Fish Commission, Neosho, Missouri, then read a paper on the subject, "Discouragements in the Culture of Black Bass."

Mr. Titcomb: After the discussion on this paper, if there is any, there is a very short paper simply asking questions on bass. If the audience have the patience I should like to see this whole bass matter straightened out this morning. Mr. Clark also has a paper from Mr. Lamkin, the fish culturist, in Georgia.

Mr. Clark then read a paper by Mr. J. B. Lamkin on the subject, "A Few Points on the Black Bass for Discussion."

Mr. Clark then read a paper by Dr. James A. Henshall on the subject, "Food and Game Fishes of the Rocky Mountain Region."

Motion was made, seconded and carried that the discussion of the paper be postponed until the afternoon session.

A recess was taken until 2 o'clock, same day and place.

AFTERNOON SESSION, 2 O'CLOCK.

Meeting called to order by the president.

The President: I regret to be obliged to announce that Prof. Reighard's paper on "The Meaning of the Secondary Sexual Characters of Certain Fresh Water Fishes," and Prof. Reighard's and Prof. Ward's paper on "A Method of Measuring the Efficiency of Quantitative Plankton Nets" cannot be presented this afternoon for the reason that they were unable to make arrangements to get the current to enable them to exhibit the lantern slides.

The secretary, Mr. Peabody, then read a paper by Mr. W. T. Thompson, of New Hampshire, on the subject, "Feeding—Its Effect on Growth and Egg Production."

The President: It affords me great pleasure to announce that Hon. George M. Bowers, United States Fish Commissioner, is fortunately with us. He arrived this noon, and as we have done ourselves the honor of electing him our president, I earnestly request Mr. Bowers to come forward and let me introduce him to the society. (Applause).

Mr. Bowers: Mr. President and gentlemen, I very much appreciate the honor you have conferred upon me, but from the fact that I am not a speechmaker and that I do not desire to delay the business of this society, and from the further fact that quite a number of its members are anxious to leave on the 3:15 boat, I simply at this time again express my thanks and hope to show my appreciation for this honor by endeavoring to do, as I try to do always, my duty. (Applause).

The President: Mr. Bowers' efforts in the line of fish culture have elicited the warmest approbation from people throughout the country interested in that subject, and it will give me great pleasure to deliver the baton of office into his hands when I am through with it this afternoon.

The committee appointed to audit the treasurer's report then presented their report, finding that the treasurer's report was correct.

Report adopted.

Dr. Birge: I have a paper from Arthur Sykes of Wisconsin, which, if there is no objection, I would like to present to the society.

Dr. Birge then read a paper by Mr. Arthur Sykes on the subject, "Inbreeding Pond-reared Trout."

Secretary Peabody: That concludes the papers.

Dr. Birge: We are all greatly disappointed in not hearing Prof. Reighard's paper and the joint paper of Prof. Reighard and Prof. Ward. I suppose that the absence of the lantern makes it impossible to give them. Would it not be possible, however, for them to furnish for the transactions a general statement of the contents of the papers, so that we could get them in printed form.

Prof. Reighard: I think it would be possible.

The President: As a committee to prepare such biographical mention of the members who have died during the past year as may be deemed proper and in accordance with the usages of the society, I will appoint Dr. Bean, Dr. Birge and Mr. Willard to make report at the next meeting of the society.

Mr. Titcomb: May I enquire if the photographs furnished by Mr. Lydell will be published with his paper?

The Secretary: Yes, I intend to have them in. I have selected some.

The President: I would enquire if the lectures with lantern slides, "A Method of Measuring the Efficiency of Quantitative Plankton Nets," and "The Meaning of the Secondary Sexual Characters of Certain Fresh Water Fishes," could be given in the transactions without the slides.

Prof. Reighard: I do not think so. A good many of the illustrations are colored. I think the most that could be attempted would be an abstract of the articles, perhaps with some illustrations.

Mr. William H. Boardman, of Rhode Island: A good many of us who come here eager to learn are confronted with a rather perplexing situation. These topics are taken up, papers presented, long and exhaustive discussions had—but no conclusions reached. Now, how are we to decide who is right? I think that by some means a definite decision where possible should be made, settling once for all points which can be settled by us, so that it will not be necessary to take them up again, and so that we may know something of what we have accomplished.

The President: You will have to do as an old German justice of the peace used to do; he always said, "The last fellow got the best speech and I gives him the case."

Mr. Peabody: I move that the society tender a resolution of thanks to the United States Fish Commission for its kindness in putting the steam launch Shearwater at our disposal, and also for the great interest that the commission has shown in being represented here in such large numbers, in furnishing so much material for our discussions, and affording such great help to us in forwarding the work of the society.

Motion seconded and unanimously carried.

Mr. Bowers: I desire to offer a resolution heartily thanking the officers of this association for the conscientious and able manner in which they have performed their several duties, and to congratulate them upon the successful work of this society during the past year.

Motion seconded and unanimously carried.

The President: Before we close I wish to thank the society for the meeting, which to me has been one of great interest and satisfaction. The duties of the presiding officer have been simplified and made very easy by the excellent order maintained. I found it the least difficult convention to manage that I ever presided over, and our meeting has certainly been pleasant and, I hope, instructive to us all. I certainly have derived great benefit and pleasure from the papers and discussions we have had, and want to say to all of you who failed to meet us at Wood's Hole when our last convention was held there, that you will lose a large fraction of the pleasures of life, if you fail to go there next year, for it is certainly worth a trip across the United States to see that country and the work that the United States Fish Commission is conducting there. It will enlarge our vision very much on the subject of fish culture, and its concomitant studies. Thanking you for your kindness and courtesy to me during my presidency, I now lay aside the mantle of office, proud and gratified that it falls upon such worthy shoulders as those of my honored successor. (Applause).

Mr. Bowers: Before we adjourn, I desire to present to the society Dr. Green, of Dayton, Ohio, representing the Ohio state commission. (Applause).

Dr. Green: The gentlemen in Ohio have been absent from your convention from choice, not necessity. I am glad to say to you that while you have honored our state with your presence, we are sorry not to have been with you more frequently, but we are with you in spirit. We are trying to do the best we can. We have the best game and fish laws in the world, especially in regard to Lake Erie. We have been handicapped very much with our laws there, but we are in a much better position now, and we are going at matters in the right spirit, and intend to enforce the laws. We will have a patrol boat from which we expect great results. I am glad to meet you all and hope to see you at some future time. (Applause).

President Bryant: The society hopes that the commission of the state of Ohio will be with us hereafter and co-operate with us in the good work we are carrying forward, and we wish all fish commissions godspeed. We have appointed a committee to endeavor to stimulate and promote among the various state commissions the best methods of interesting the public and getting a right public sentiment in respect to the protection and propagation of fish.

Mr. Dean: In regard to the meeting next year, I understand there is an invitation for the ladies to come to the clambake. Does that mean we are to bring the ladies next year?

Dr. Birge: Anybody that can get the price of a ticket had better bring them.

The President: There were several ladies at our convention last year and they enjoyed themselves very much, and everything was done to make it pleasant for them. There is a standing invitation to the ladies to come to our conventions.

The society then adjourned sine die.

Deceased Members since last meeting:

James Benkard.

Prof. B. Benecke.

Prof. A. J. Malmgren.

J. S. Van Cleef.

E. H. Friesmuth, Jr.

PART II.

PAPERS AND DISCUSSIONS

THE HABITS AND CULTURE OF THE BLACK BASS.

BY DWIGHT LYDELL.

In this paper I shall try to set down the experiences that I have had in the nine seasons, beginning with that of 1894, during which I have had charge of the Black Bass work of the Michigan Fish Commission. This work was begun at Cascade, Michigan, and after four seasons was transferred to Mill Creek, where it is now carried on. Since the methods of pond culture that have been finally adopted are based on a knowledge of the breeding habits of the fish under natural conditions, I shall begin by describing these habits. The account has reference to the Small Mouth Bass, unless the Large Mouth is specified.

In studying the habits of the bass it is necessary to distinguish the males from the females at a considerable distance. Ordinarily, it is not possible to distinguish them except by dissection, but just at the spawning time the female is distinguishable even at a distance of 10 or 20 feet on account of her distension with eggs. By this means I have been able to make out the part taken by each sex in nest building and the rearing of young. I have several times, while watching the fish, verified my determination of the sex by seining the fish in question and dissecting it, have invariably found that I had determined the sex correctly.

I do not hesitate to say that the nests of the black bass are built by the male fish working alone. The small mouth prefers a bottom of mixed sand and gravel, in which the stones range from the size of a pea to that of one's fist. As the spawning season approaches the male fish are seen moving about in water of 2 or three feet depth seeking a suitable nesting place. Each male tests the bottom in several places by rooting into it with his snout and fanning away the overlying mud or sand with his tail. If he does not find gravel after going down 3 or 4 inches, he seeks another place. Having found a suitable place he cleans the sand and mud from the gravel by sweeping it with his tail. He then turns over the stones with his snout and continues sweeping until the gravel over a circular spot of some 2 feet in diameter is perfectly clean. The sand is swept toward the edge of the nest and there forms a rim a few inches high, leaving the center of the nest concave like a saucer. The nest is usually located near a log or large rock so as to be shielded from one side If the bank is sheer and the water deep enough, the nest may be

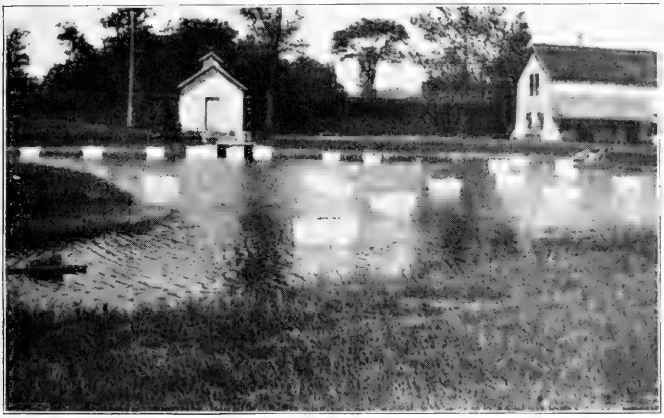
HATCHING BED.

built directly against the bank if possible. It is always so placed that the fish can reach deep water quickly at any time.

During nest building no females are in sight—but when the nest is done—and this takes from four to forty-eight hours—the male goes out into deep water and at once returns with a female. Then for a time—it may be for several hours—the male exerts himself to get the female into the nest and to bring her into that state of excitement in which she will lay her eggs. If she lies quiet he turns on his side and passes beneath her in such a way as to stroke her belly in passing. If she delays too long he urges her ahead by biting her on the head or near the vent. If she attempts to escape he heads her off and turns her back toward the nest. If, after all, she will not stay in the nest, he drives her roughly away and brings another female.

Some fifteen to thirty minutes before the female is ready to enter the nest and spawn, her excitement is made evident by a change of color.

Ordinarily, she appears to be of a uniform dark olive or



SHOWING BEDS SCREENED.

brown above, changing to a light green below. The only markings readily seen are four stripes on each cheek. In reality however, the sides of the fish are mottled with still darker spots on the dark olive back-ground. The spots are arranged so as to form irregular, vertical bands like those on the perch—but these are not usually visible. Now as the excitement of the female increases the back-ground becomes paler and finally changes to a light green or yellowish hue so that the spots and bands stand out in strong relief. The whole surface of the fish becomes thus strongly mottled. This is a visible sign that the female will soon spawn. The male undergoes a similar but less pronounced change of color.

Soon after this the female enters the nest and the male continues to circle about her, glide beneath her and to bite her gently on the head and sides. At times, he seizes her vent in his mouth and shakes it.

When this has continued for a time spawning takes place. The two fish turn so as to lie partly on their sides with their vents together and undergo a convulsive fluttering movement lasting three to five seconds. During this time the eggs and milt are extruded. The circling movements are then resumed, to be interrupted, after a few seconds, by spawning. This alternate circling and spawning continues for about ten minutes. The

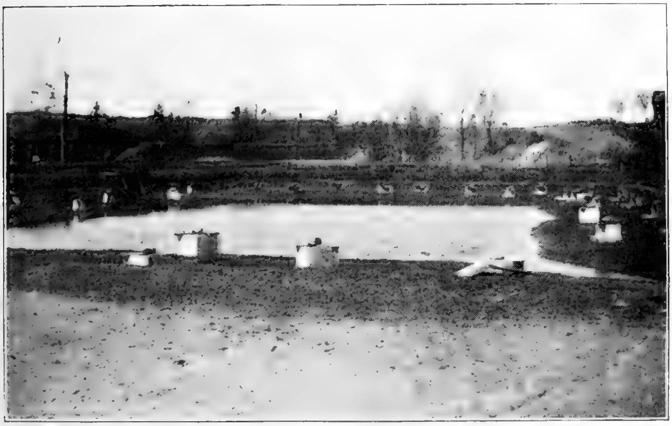
POND AFTER BEDS HAVE BEEN SCREENED.

male then drives the female away, biting her and showing great ferocity. She does not return.

The male and the male only, now continues to guard the nest, fanning sediment from the eggs and repelling enemies. At 66 degrees Fahrenheit the eggs hatch in five days and the young fish swarm up from the bottom in twelve to thirteen days from time eggs are hatched.

Henshall in his "More About the Black Bass" published in 1898, quotes, with approval, Arnold's observations to the effect that the nests are built and then guarded by the female. Page in the "Manual of Fish Culture" published in 1897, by the United States Fish Commission, speaks of the nests as being built by the mated fish sometimes working together, and sometimes working separately. These seem to be the latest published observations,—and are not at all in accord with my observations in Michigan.

After the young small mouth bass rise from the nest they soon scatter out over a space 4 or 5 rods across. They do not form a definite school, with all the fish moving together, but a very loose swarm in which the fish are moving independently, or in small groups. This habit makes it impossible to seine the young fry, as upon the approach of the seine, instead of keeping together, they at once scatter and escape the seine. The fry may be at the surface or on the bottom in weeds or clear water. They are attended by the male until they are an inch and a quarter



POND DRAWN DOWN WHILE SETTING BEDS.

long. The swarm then gradually disperses and the young fry, which were previously black, take on the color of the old fish.

The breeding habits of the Large Mouth Black Bass are similar to those of the small mouth, but differ in some respects which are of importance in pond culture.

1. The nests of the large mouth are not made on gravel, but by preference on the roots of water plants. These are cleaned of mud over a circular area and on them the eggs are laid. As the large mouth eggs are smaller and more adhesive than those of the small mouth, they are apt, when laid on gravel to become lodged between the stones and to stick together in masses. They

are then smothered. When laid on the fibrous roots of water plants this does not occur.

2. The young remain together in a compact school very much smaller than that of the small mouth and the fry usually move all in the same direction. This makes it easy to seine the large mouth fry when wanted.

CULTURE OF BLACK BASS.

1. *Ponds and Stock Fish.*

After some experimenting, all our ponds, both for stock fish and fry, are built on the model of a natural pond. There is a

POND DRAWN DOWN WHILE SETTING BEDS.

central deeper portion or kettle, about 6 feet deep, and around the shore a shallow area where the water is about 2 feet deep. The bottom is the natural sand, and water plants are allowed to grow up in the ponds. All ponds are supplied with brook water, and silt from this furnishes a rich soil for the aquatic plants. The water of these ponds contains Daphnia, Bosmina, Corixa and other small aquatic forms in great numbers. These furnish food for the bass fry. The ponds run in size from 120 feet by 190 feet to 100 feet by 100 feet.

At first we were unable to feed the stock fish on liver, but after a time we found that by cutting the liver into strips of about the size and shape of a large angle-worm and by throwing the strips into the water with the motion that one uses in skipping stones, they wriggle like a worm in sinking and are then readily taken. The liver must be *fresh!* We found, however, if the fish are fed on liver alone they do not come out of winter quarters in good condition. Of eleven nests made by bass thus fed, only three produced fry. Although eggs were laid in all they seemed to lack vitality owing to the poor condition of the parent fish, and in eight of the nests the eggs died.

In order to bring the fish through the winter in good condition it is necessary to begin feeding minnows in September, and to continue this until the fish go into winter quarters.

HAULING DAPHNIA.

The bass eat minnows until they go into winter quarters, after which they take no food until spring. The minnows are left in the ponds over winter so that the bass, when they come out of winter quarters, find a plentiful supply, which lasts them until the spawning season. At this time the minnows are seined from the pond as their presence interferes with the spawning. Before this, however, some of the minnows have spawned and their fry later serve the young bass as food. When bass are fed in this way, they come out of winter quarters in fine condition and their eggs are found to be hardy.

2. *Artificial Fertilization.*

During the first two or three seasons of our work numerous attempts were made at *artificial fertilization,* but like all other attempts of this sort, these proved to be failures. Only twice did I succeed in artificial fertilization. On one of these occasions the female was seined from the nest after she had begun to spawn. She could then be readily stripped. The male was cut open and the eggs were fertilized with the crushed testes. About 75 per cent of the eggs hatched on a wire tray, in running water, the eggs being fanned clean every day with a feather.

In the second case the fish were seined while spawning and it was found that in the case of one female, pressure on the abdomen caused a reddish papilla to protrude from the vent. This had the appearance of a membrane closing the vent. It was pinched off and the female then stripped readily and the eggs were fertilized and hatched.

3. *Pond Culture.*

Having abandoned artificial fertilization, our attention was next turned to *pond culture* and this we have carried on for about six years. Our earlier ponds were not of a sort to furnish natural spawning ground. For this reason we constructed along side each of the large ponds, six smaller ponds to be used as spawning ponds. Each of these was about 16 by 24 feet, 16 inches deep, with gravel bottom, and was connected to the central pond by a 4 foot channel.

The fish entered these and spawned. In one case we had eight nests in a single pond of this sort. Where as many nests as this were made, usually but one or two of them came to any good, the others being destroyed by the fighting of the male fish. Ordinarily, but one or two nests were built in each spawning pond. The male fish first to enter and begin the construction of a nest, generally regarded the whole pond as *his* property and held it against those that tried to enter after him. On one occasion the male thus holding the pond was attacked by ten or twelve other males at one time and after a long struggle was killed and his nest destroyed.

4. I now gave up the attempt to use small spawning ponds and had nearly all my ponds made of good size and with a central kettle and shallow shore area—as already described. The problem now was to prevent the fighting of the male fish and the consequent destruction of nests and eggs. I finally hit upon

what seemed to be the two chief causes of this fighting and found remedies for them. I had noticed that in the natural water the nests of the small mouth bass were frequently built against a stone or log so as to be shielded on one side. When they were so built the nests might be quite close together, as near as 4 feet, and the fish did not fight, because they did not see one another when on the nest. On the other hand, if a bass nest was built in a situation where it was not shielded the bass on that nest would prevent any other bass from building within 25 or 30 feet of him. It occurred to me then to try to construct artificial nests and shield them so that the fish on the nests could not see one another. In this way I hoped to be able to place the nests so near together so as to fully utilize my pond area and still not have them destroyed by fighting.

In the spring before the spawning season opened, I drew down the ponds so as to expose the shallow terrace along the shore. This terrace was then cleaned to a depth of about 2 inches of sediment and vegetation which had accumulated since the previous summer. Rectangular nest frames 2 feet square of inch board were now made. On two adjacent sides these frames were 4 inches high, while on the other sides they were 16 inches high. They were without bottoms, that is, were frames not boxes. The frames were then set on that part of the bottom where there would be about 2 feet of water when the pond was filled. Each was so set that the corner formed by the junction of its two lower sides pointed to the center of the pond while the opposite corner formed by the higher sides pointed toward shore. The frames were set directly on the bottom, not in excavations and each was filled with gravel containing sand and suitable for nest building. A board was laid diagonally across the two higher sides and a heavy stone laid on this to keep the frame in place. The effect of the two higher sides of the frame is to form a shield on two sides of the nest; while the board across the top affords shade. The frames were set in two rows about the pond, parallel to the shore line.

The rows were about 6 feet apart and the nests in each row about 25 feet apart, alternating with those in the other row. There was thus about one nest to each 100 square feet of suitable bottom, or in each area 10 by 10 feet. When the bass were on the nests no one was able to see any other and the fighting from this cause was practically eliminated. The number of rows of nests may be increased to three, or four, or more where the area of shallow water is wide enough.

The bass selected these nests in preference to any other spawning ground. They cleaned up the gravel and behaved in the nests in every particular as they would on natural spawning grounds. The first time we tried these shielded nests, not a single bass made a nest outside them, though there was plenty of good gravel bottom available for the purpose.

I come now to the second cause of fighting. The first season that we tried these nests (1900) we got from 475 stock fish 315,000 fry and 750 fingerlings. In the season of 1891 the output was very much less and there was considerable fighting among the fish. This remained unexplained until the ponds were drawn down after the spawning season, when it appeared that, although the fish had been sorted, the number of male fish was considerably in excess of the number of females. It was these excess males that had made trouble. Banding together they went about breaking up the nests of their more fortunate brothers. It is now our practice when we set the nests to seine out the stock fish and sort them putting about forty males to sixty females. Since each male is thus abundantly provided for, the second source of fighting is gotten rid of.

During the present season up to May 26th we had produced from 493 adult fish 430,000 fry—and we believe that we can do as well every year.

5. Up to the present year we have been troubled with two sources of *loss incident to our water supply.* The supply is a spring fed brook which runs over an open country before it reaches us. The water in this brook becomes quite warm on a hot, sunny day and cools off at night. The temperature thus falls at night sometimes as much as 13 degrees Fahrenheit and becomes as low as 46 degrees Fahrenheit. This is disastrous, since, when the temperature gets below 50 degrees Fahrenheit the adult fish desert the nests and the eggs or young fry are killed by the sediment. We have lost many fish in this way. We now get over the difficulty by watching the temperature of the

water and when it approaches 50 degrees Fahrenheit, we shut off the supply and keep it shut off until the water warms up. Since the ponds are well stocked with water plants the fish do not suffer from lack of oxygen when the water is shut off. Indeed, if the water did not leak out of the ponds I doubt if it would be necessary to introduce any running water into them during the breeding season.

The *second difficulty with our water supply* has been from sediment brought down by the brook after heavy rains which has sometimes accumulated over the nests so thick as to smother the eggs and drive away the parent fish. This difficulty also we now get over by shutting off the water supply whenever the water is much roiled.

The only difficulty with shutting off the supply is that the level of the water must be kept fairly constant. If it lowers more than about 6 inches, the fish leave their nests and the eggs die. For the purpose of maintaining a constant water level it would probably be best to have the ponds made with clay bottoms. The difficulties arising from roily water of variable temperature are, however, local and would probably not be usually encountered.

6. I have still to speak of the *handling of the fry after they rise from the nest and of rearing them to fingerlings.*

The fry of the small mouth have the habit of scatttering into a large swarm when they leave the nest, and it is consequently difficult to seine them when wanted. I have therefore adopted the practice of setting over each nest, just before the fry rise from the bottom, a cylindrical screen of cheese cloth supported on a frame of band iron. I first remove the wooden nest frame. The screen keeps the fry together. They thrive and grow within it and may be left there until one desires to ship them. The old fish stays outside and watches the screen. The fry feed on the crustacea inside the screen. When this supply is gone other crustacea may be taken from the pond with a tow net and placed inside the screen. We remove the fry from these screens directly to the shipping cans as wanted.

In order to raise fingerlings, I lower the water in one of the ponds, seine the old fish out of the kettle, and transfer them to another pond. Then I refill the pond and put in my fry, now about one-half to three-quarters of an inch long. The water in the pond is thick with Daphnia and other crustacea and these do not go out when the water is drawn off. The fry feed on them and the supply is usually sufficient—but if it gives out, a fresh supply may be gathered from one of the other ponds and placed in the nursery pond. As the young bass grow they eat not only the Daphnia but young Corixa and doubtless other aquatic animals.

In 1901 fry one-half to three-quarters of an inch long were introduced into the nursery pond on July 12th, on August 5th they were seined out and shipped and were then 2 to 3 inches long. They had had none but the natural food! In three months these fish, under the same conditions are 4 to 6 inches long.

7. I have spoken so far of the small mouth and it remains to say *something of the large mouth,* with which my experience is more limited. It is less necessary to resort to pond culture with them since, owing to the habit of the fry of keeping in a close swarm, they may be readily seined from their natural waters shortly after they have left the nests.

In culturating them in ponds I use the shielded nests already described,—but make the bottom of some fibre, preferably Spanish moss bedded in cement, similar to those used by Stranahan described in the report of this Society for 1900. This imitates the natural nest bottom and gives better results in our locality than the gravel nest. I do not place screens about the nests, since the young fry are so small that it is difficult to hold them with a screen and since they may readily be taken with a seine when wanted. I allow the large mouth fry to leave the nests with the parent fish and seine them when wanted.

Finally, I will sum up what seem to me to be important points in pond culture of small mouth black bass. I assume the ponds to be constructed, as is usual, on the model of a natural pond with a central kettle and shallow shore region. They should be well grown up with water plants and should be supplied with lake or brook water.

1. Fish should be so fed (with minnows) as to be in good condition in the spring.

2. They should be sorted into the ponds in the spring in about the proportion of four males to six females.

3. Shielded nests should be used, arranged as already described—about one to each 100 square feet of shallow water.

4. The gravel used in the nests should be carefully selected; it should contain sand and plenty of small stones.

5. Water on the nesting grounds should be kept constantly at a level between 18 inches and 2 feet.

6. The temperature of the water should be kept constantly between 66 degrees and 75 degrees Fahrenheit (in our locality).

7. Roily water should be as far as possible kept out of the ponds during the spawning season.

8. Fish should not be disturbed until the eggs are hatched.

9. The small mouth nests should be screened just before the fry rise from the bottom.

10. The water should contain an abundance of natural food for the fry.

In closing I may say that I can see three ways in which my procedure might be improved.

1. I should provide special nursery ponds for rearing fingerlings.

2. I should try nest frames shielded on three sides instead of on two sides. I should make them with a bottom and when the fry rise from the nest I should close the fourth side of the nest frame by sliding a screen into it. In this way I should not have to remove the nest frame and put a screen over the nest, but would simply leave the frame in place and close the open side with a screen.

3. I should make the ponds with clay bottoms, so that if necessary the water supply could be entirely shut off during the breeding season.

FROM MILL CREEK HATCHERY:

Total output during year, ending at present time:

Small-mouthed bass fry	404,000
Big-mouthed bass fry	618,000
Fingerlings	36,050
Total	1,058,050

DISCUSSION OF MR. LYDELL'S PAPER.

Before his paper was read, Mr. Lydell said: On the subject of the black bass we have not committed ourselves to anything, because the more you say about this question, the less you have to take back later on.

At the conclusion of his paper, he said: And in closing, gentlemen, I wish to thank Professor Jacob E. Reighard for assisting me in preparing this paper.

Mr. Clark: This is a very valuable paper and Mr. Lydell has given the bass question as much study probably as any man in the United States. There is one problem of bass culture in which I am greatly interested and upon which I should like to hear from some of the bass men, for I am no bass man myself, although I have bred a few. We have those here who have given the subject a great deal of thought, and the one particular question to which I have reference is in regard to the planting, whether they think that bass fry deposited when two or three weeks old, are as valuable for our lakes and streams as those planted when three or four inches long, as fingerlings.

The President: I regard the paper as very interesting and valuable and one that is entitled to great attention, as Mr. Lydell may be regarded as one of the pioneers in this pond culture of bass.

Mr. Stranahan: In order to get this matter started a little bit, I would like to ask Mr. Lydell what he considers fry in his specimens.

Mr. Lydell: The small-mouth bass I consider fry the moment they commence to swim, and the moment they commence to swim up they commence to take food; and I consider them as fry, though before we get through shipping some of them are an inch long.

Mr. Stranahan: Show me what you commence on, if you please.

Mr. Clark: I would like to have Mr. Lydell tell us at what time they cease to be fry and become fingerlings, or perfect bass.

Mr. Lydell: The difference between fry and fingerlings is this: After they have changed their color, after they take on the color of the old fish, they are then one and a half to two inches long, and then we commence to call them fingerlings. We have got to establish a point somewhere.

Mr. Clark: About how old are they?

Mr. Lydell: About 40 days old.

Mr. Clark: Then one that was 15 to 20 days old you would not call a fingerling?

A. No, sir.

Q. I would like to ask the question: Is not a large-mouth bass as perfect a fish at 15 to 20 days old in a temperature of water at 70 degrees, as one three months old?

A. It is at 20 days as perfect a bass as at three years.

Q. I would like to ask further, if you do not think that this fish planted in that water is equally as good with the exception of the protection you give to it, as one three to six months old?

A. Yes, sir.

Mr. Clark: The society will perhaps remember that I have always been a yearling man, but I am not so considering bass. Gentlemen, this is the point I am trying to get at. I do not like to see it undertaken to raise only about 50,000 fingerlings out of a half million fry, for I heard one superintendent say last night that it took half a million with him to raise 50,000 fingerlings. Now, if these fish are as well and perfect at the age of 20 days, and Mr. Lydell can plant 300,000 out of 500,000 at that time, and only 50,000 from three to six months old, then I think it is time that the matter was looked into.

Mr. Stranahan: I am of Mr. Clark's opinion, thoroughly. I have been advocating it for two years—made recommendations, and have written official reports urging the planting of these smaller bass. They are perfect bass, they are taking their food, they are old enough and smart enough to take care of themselves, and they are afraid of their enemies. Our former chief of fish culture was a great stickler for fingerling, and the larger the better, and we had it out in numerous discussions, and I am glad to say that our new chief of division seems to be in favor of planting smaller fish and more of them. I refer to the large-mouth bass—I have had little experience with the small-mouth variety. I had some experience north some years ago, and got good results from planting fry in streams in which the fish were not indigenous. We got splendid results there from planting fry of the small-mouth bass.

Mr. Titcomb: I do want to say about this paper that I feel as if I was amply repaid for coming here just to hear it, if I did not hear anything else during the session; I think it is the best article on black bass I ever saw, by far, and I think it is going to help all the members of the United States Fish Commission to solve this bass problem. From what experience I have had since I came into my present position, I find that we have not solved this question. Mr. Leary has been planting fry at San Marcos with good success; this year a beginning was made at Mr. Stranahan's station of doing the same thing. While I have been a fingerling man to a certain extent, yet my views about the bass are that they are well able to take care of themselves when they are young, and it is much better to plant half a million or a million of these fry than it is to wait until you can plant only a hundred thousand, with the balance inside of the hundred thousand.

I wanted to ask one question about temperatures: What extremes of temperature will the adult fish stand in your waters?

Mr. Lydell: We have a temperature of 90 degrees there sometimes during the day. During the spawning season we must be very careful about the temperature. On a warm day, with lots of sun, the temperature may go up to 72 degrees, but when you get up the next morning and you have a temperature of 49 degrees or 50 degrees, and if any bass have spawned during the previous day you will find that the bass have deserted their bed and that the eggs are dead. But the temperature does not range much higher than 90 degrees for more than a few days, but during the summer months, after the spawning season, the water is allowed to run all the time, and it will cool down to 60 degrees every night during the summer, and the minute the sun strikes it in the morning it will commence to warm up, and as soon as the sun goes down the springs flow in, and of course it is cooled again, but our fish do not seem to take any harm from it at all.

Mr. Titcomb: One more question: In this water of yours is it equally favorable for both the large and small-mouth bass, or do you want different qualities of water for the two varieties?

Mr. Lydell: I have experimented some with the large-mouth bass this year and last year, and I find the water very favorable for them. Prof. Reighard saw us haul 48,000 large-mouth bass nearly an inch long at one dip of the seine in one of our ponds. We had only 30 specimens of the large-mouth bass at our hatchery this year, and from those I think there were obtained something over 100,000 fry, although only five productive beds were made. They were a scattering lot we picked up and did not know whether they were male or female. We put in the same pond quite a lot of small-mouth bass, and the two varieties did not quarrel or injure one another at all. The large-mouth bass were allowed to roam about the pond with 75 or 80 of the old small-mouth bass, and the small-mouth bass that spawned in there were in fifteen beds, and we screened those and took care of them in the usual way. There was plenty of daphne growing in the pond and lots of food for the large-mouth bass; and these bass that I have here were from that lot.

(Referring to specimens).

This bass thirty days old I took from the nest and put in a cage and kept there, and in that way I kept accurate account of them. (Referring to specimens).

Mr. Titcomb: You must have an unusual amount of aquatic life in the ponds.

Mr. Lydell: You can dip it up with a dipper anywhere around the ponds in the spring. We have to mow our ponds twice every year.

Mr. Stranahan: Is the water hard or soft?

Mr. Lydell: Some soft, and lots of spring water.

Mr. Stranahan: Is there lime in that?

Mr. Lydell: No, no lime.

Mr. Titcomb: Is there any other kind of plant life than you have named in the paper?

A. There is the cara and potamogeton, that is all.

Mr. Titcomb: You did not get all the large-mouth bass of which you mention, the total output, from these ponds—did you?

Mr. Lydell: No, sir, we had two auxiliary ponds. One is a small pond connected with the Soldiers' Home, from which we get lots of large-mouth bass, and another one we have rented, of the extent of probably one and a half acres, from a farmer. That is where we get our large-mouth bass from now, principally. We have no room there to hatch them with the exception of what I have hatched there this year, about 100,000.

Mr. Titcomb: Did you ever see any large-mouth bass flirt with a small-mouth bass, as described in the paper?

Mr. Lydell: Not a particle: We had a pond where the large and small-mouth bass were mixed up purposely—the old ones—and the beds around the shore alternately were some of them Spanish moss beds and some gravel; and we had two pair of large-mouth bass that spawned on the gravel; although they did not amount to much. Their eggs settled down in between the stone and seemed to smother. On the other hand we had three pair of small-mouth bass that spawned on this fiber, and we got excellent results from them, but I think the reason they *did* spawn there was because they seemd to clean down and try to fan off that fibrous matter, and could not, but got to the cement and thought it was rock, and spawned there. But we had one trouble—we could not raise the nest away and screen it. If we made a screen big enough to get the whole nest, we could not catch the young bass.

Mr. Titcomb: As I understand it, it is necessary for the preservation of those eggs that the parent fish should fan them.

Mr. Lydell: Yes, sir, I think so.

The President: In our ponds at Minocqua we excavated them there and found the spring water coming in out of the gravel in considerable quantities. Do you think that was a detriment or advantage?

Mr. Lydell: It would not be a detriment unless there was too much of it. If you could get a temperature of 66 degrees and keep it there, I do not think the spring water would affect your bass in the least.

The President: What are the best dimensions for ponds for bass growing?

Mr. Lydell: If I were to rebuild our ponds over at Mill Creek, where I have these ponds, I would make them larger. Our last pond we built is the most successful.

The President: What is your judgment, Dr. Birge, of the dimensions of our ponds at Minocqua?

Dr. Birge: The lower pond must be about 300 feet long and the others 150 to 200 feet.

The President: And 60 or 80 feet wide?

Dr. Birge: Yes.

Mr. Brown: If there is much spring water coming into the bed the temperature would be too cold, would it not?

Mr. Lydell: Yes, if they could not keep the temperature up.

Dr. Birge: The spring water does not affect our temperature. It is a sort of a seepage spring, not a strong flowing spring, the temperature being somewhere in the region of 50 degrees Fahrenheit, and the lake water offsets what little spring water comes in. I should like to hear more about this matter of the size of the pond; and especially as to the margins.

Mr. Lydell: I have here a view of one of our ponds, 190 by 120 and six feet deep in the center. There is a margin of probably thirty feet clear around the pond and there is an island here; it has a shallow margin clear around the island to the shore, and there is a big pocket in the center of the pond 50 by 30, and six feet deep, and that is all the deep water we have in the pond, and that runs gradually to six feet. You will find the fish there invariably in the winter time, and all summer, unless they come out for minnows.

Dr. Birge: The broad margin of your pond is a decided advantage, of course. You need that for a spawning bed. If you made your pond large, would you make it irregular in outline so as to give you more margin?

Mr. Lydell: I would. Our ponds are nearly all irregular, and we get better results thereby.

Mr. Stranahan: What do you consider a proper number of small-mouth or big-mouth bass for an acre of water, everything being favorable.

Mr. Lydell: I would put into an acre, I should judge, about something like 200 females and 160 males, small-mouth bass.

Q. You would not think that excessive?

A. No.

Q. How about the big-mouth bass?

A. I am not posted on that.

Q. What is your opinion about it?

A. I would not put as many in in this little lake that we rented. By the way, I think renting that little lake was one of the greatest things that the fish commission ever allowed me to do. I rented it for $10 a year, if the output does not exceed 75,000, and if it does, I must pay the gentleman $15. Of course that is a lot of money.

Dr. Birge: That must affect your $75,000 considerably.

Mr. Lydell: I put the first season into that lake 48 or 50 fish raised at the hatchery, two years old, large-mouth bass. I think it was something like 60,000 or 70,000 fry I got out of there the first season, and last fall I procured forty-four or more large-mouth bass, adults, weighing anywhere from two to three pounds, and put them in there. I also put in a couple of wagonloads of minnows, probably 50,000 or 75,000. This year we got from that pond 262,000 fry, and 8,000 fingerling, and I was quite sorry that it went to that number, because the fish commission had to put up another $5. (Laughter). We have absolute control of this pond, and it is covered with chara nearly all over, with the exception of a little in the center; and on one end there are some pond lilies. It is nothing but mud; you cannot wade anywhere near it without rubber boots, and then you are liable to drop through the bogs, and there is only one place for them to spawn, and that is on the pond lily roots; and we had bass beds in that lake this year that were over ten feet across, and I went there as the young bass were coming up off the beds, and I presume two or three pair of bass must have spawned on that particular spot, for the young bass were coming up all over that bed, where it had been cleaned. You could see them if the sun happened to be just right. We let those alone in that pond—paid no attention to them—until they were about 15 days old, when they were all taken out of there, and nearly every fish that was shipped from that pond was one and a half inches to one and three-quarters long, and we took them with a seine.

Mr. Titcomb: What was the area of that pond?

A. I should judge it was about an acre and a half—it is a small pond.

The President: Let me ask you a question on another line: At our Minocqua hatchery we are right in a nest of bass lakes, and every spring we can catch with our seines easily and without trouble, enough bass to put into our ponds. Now, would you prefer that method to keeping them in constant confinement? If you were situated so that you could get your brood fish by going right out into the wild lake and seining them and putting them into the ponds during the season of propagation, would you do that or would you keep them in stock all the time?

Mr. Lydell: If I could I would get my spawning fish in the fall of the year—what I need—I would hold all I could in my ponds and feed them, domesticate them as much as possible. I find that the wild fish when spawning season comes on are very shy; they will come up on the shore and make their nests, and if you happen to go along there, which we do not allow anyone to do during the spawning season—no visitor or employe is allowed to go around the ponds during the spawning season unless it is absolutely necessary—our superintendent cannot go down there unless it is absolutely necessary for him to go—they go just enough to feed the fish—I find that when these wild fish come out and spawn, they scoot off to deep water on the slightest provocation—they rush back and forth all the while. But our fish that we got the latter part of the year were domesticated so that you could get within ten or twelve feet of the nest and see the bass lying under the shadow of the board, guarding his bed. Of course if you went up close he would go away, but he would come right back, and I have oftentimes waded right up to the bed, put my hand on the stone, and the bass were lying there. Those were domesticated bass that we have had there several years.

Mr. Clark: Don't you think they are acquainted with Dwight Lydell and know him, so that they don't go away?

Mr. Lydell: I could not say as to that, but they say good morning to me every time I see them. (Laughter).

The President: Mr. Lydell has satisfied me that there is a good deal of human nature in bass, even to a degree of modesty in courtship. (Laughter).

Dr. Birge: I should like to ask a question along another line: You spoke in the suggestion at the end of your paper, of making the boxes protected on three sides, and then putting a screen in on the fourth side to avoid moving the nest frame and putting a screen over the nest. If that were the case, should not the sides of the boxes be made high enough to stick up out of the water?

Mr. Lydell: Certainly—our boxes that we have now with protected sides are sixteen inches high; but I will raise the new boxes up above the two-foot level.

Dr. Birge: You will get circulation of water enough if you have a three-sided box coming up out of the water?

Mr. Lydell: Yes, sir, the three sides enclosed will have a strip of copper wire screen four inches wide around, near the surface of the water. With these boxes I am using now the difficulty is this, you have to wade out into your pond to take the boxes out of there, and you have to take them out. If you screened the box itself, you could not collect one fiftieth of the fry. Just as quick as you put your net in the water the fry will go to the frame immediately. But when you raise the frame out, it is filled with gravel, and the young fish are at the bottom. The sides of your gravel fall away and lots of your little fish fall outside, and some are buried in the gravel, and you roil up the whole pond. I have lost quite a few fish from that cause, although most of them are far enough along when you screen them so that they would not become injured. But with the other screen, all you have to do is to paddle around with a boat and drop the screen in at the side that is not protected.

Mr. Stranahan: How do you take the fry out of your box?

Mr. Lydell: In the same way as out of a screen. It answers the same purpose as a screen—it is a screen and box combined, and you can use the box for large-mouth or small-mouth bass as you see fit.

Mr. Stranahan: You would not make your strip of netting in the side more than four inches wide, and have it up near the top of the water?

Mr. Lydell: Yes.

Q. What mesh do you use?

A. Fine enough to hold young fry. We used the common wire that they buy for door screens, for our small-mouth bass, had it tarred two heavy coats, which lessens the size of the interstices somewhat. We do not screen any large-mouth bass.

Mr. Titcomb: When you take the fry out of the nest, you raise the nest right up, do you? I refer to the boxes that have three sides of wood and one of screen.

Mr. Lydell: Take a dip net and dip them right out. We usually take a boat, or if some of the boys have boots on, they take a tub and dip the fry out and get them all that way.

Mr. Stranahan: Is there an opening in the top of the screen?

A. Yes.

Q. And by the screen you propose now the box is open on one side with top, and to remove it you take the stone on it off?

A. We have no stone on it—that is unnecessary.

Q. You would have that loaded down with your nest inside?

A. Yes. You might lay a board across the top for shade, if necessary.

Mr. Titcomb: Do you draw your pond down in removing your fry from your boxes?

A. Never.

Q. How much water is there in the boxes?

A. Twenty inches to two feet. Young small-mouth bass are all at the top on a sunny day, and you can get two-thirds of them the first dip; then you wait awhile and they will come up again, but it will be two or three days before you finally clean up the whole school.

Q. That is before they are trained to say good morning?

A. Yes, sir. (Laughter).

The President: How high is the sand at the bottom of your box above the bottom of the box?

A. Four inches. We fill it full and concave it a little in the center.

Q. Where you had a great deal of seepage from the bottom, would it not be better to raise it a little more?

A. There would be no harm in doing so. We used to use six and seven inches, but found four inches just as good in our locality, and we do not have so much to clean out of our ponds in the fall.

Mr. Stranahan: Suppose you are going to corral the big-mouth bass. Our big-mouth bass spawns every three months. So it would be important if we could clean up the whole school and have none left to eat up the subsequent brood. Now, if you substitute your cement and Spanish moss for the gravel in the rig you describe, would it not work all right?

A. Yes, sir, if you want to ship the big-mouth bass when they first rise from the bed.

Dr. Birge: If you followed Mr. Lydell's last plan I do not see any difficulty if you wish to just take that nest after screening, right out.

Mr. Lydell: I have done that, but got no results. We had last year a lot of large-mouth bass spawn in this pond and I did not want them there, and I watched them till they were about ready to hatch, and I raised the nest up; I had added a bottom in it of this cement, and after I raised it above the water there was still two inches of water in the nest covering the eggs. I transferred those to a pond 16 x 24, and put in three or four quarts of daphne, but got no results. In the fall I think we had probably thirty or forty bass out of these three schools, where we ought to have had fifty thousand.

Q. If you had used the box and screen on the large-mouth bass when the bass had risen, you could lift the nest up and dump the bess out, couldn't you?

A. Yes.

Mr. Stranahan: I would be of the opinion that Mr. Lydell's plan of dipping them out would be better.

Mr. Lydell: If I did not want any in the pond I would dip out what I could and before taking the screen out of the nest I would take it out on the shore and rinse it out.

Q. Didn't you find that your Spanish moss rotted off toward the close of the season?

A. No, sir; I had Spanish moss that I had used two seasons, and it is in good condition for another year yet. I have used excelsior and used sea grass of some kind, and several other things. They spawned on it all, but it was only good for one season, and so I threw it away and used Spanish moss.

Mr. Stranahan: With us, late in the season it rots off. Though our water is very warm, standing 90 degrees, every day, and during three or four months running up to 100 degrees, and I think the high temperature has a tendency to rot it.

Mr. Lydell: Our beds are hardly ever in the pond more than thirty days.

Mr. Stranahan: Our beds would be occupied by succeeding bass.

Mr. Peabody: You speak of your pond that you rented, of an acre and a half, on which you raised large-mouth bass. Don't you mean to convey the idea that you have more success in that pond raising large-mouth bass than you do in your regular artificial ponds?

A. No, sir; from five beds I had something like 100,000, which is a great deal larger per cent than I had the other way.

Q. How many did you get from this one and a half acre pond?

A. Two hundred and sixty-two thousand.

Q. Were there any other fish in that pond?

A. Very few; that is the reason I rented the pond. There were a few sunfish, very small, some minnows, but hardly anything else; and there was plenty of vegetation there. In another instance we rented a lake probably four acres in extent, and put in 250 or 260 large-mouth bass, and got no results at all. There were lots of other fish, turtles, eels and everything of that kind, and our results from there were very unfavorable. In the Soldiers' Home pond two and three years ago we did very well; but this season the pond has become full of suckers, sunfish, blue gills and turtles, and our bass propagation there is commencing to dwindle. Unless we can draw that pond down and get rid of all those enemies, we will meet with failure there another year; but if I had the same pond where I could control it and draw it down as I wanted it, there would be no trouble to get a million bass from that one pond. The pond is about an acre and a half in extent.

Q. What do you consider the most injurious to the raising of bass—what enemies?

A. Small sunfish and minnows I have found do more to destroy the young bass than anything else in the world that we have ever found. I do not find that any beds are destroyed; I never found the beds destroyed, but in one of our ponds last year I carried on an experiment for my own benefit. I had, I think, fifteen beds of large mouth bass eggs. That pond was alive with minnows, and the vegetation grew up there early. About the time the young bass were coming off the nest, there was plenty of vegetation in the pond and those minnows cleaned up the large-mouth bass so that we did not get twenty-five bass out of that pond. This year with one-third the amount of bass I got nearly 100,000, but there were no minnows in there.

Q. How old must the bass be before they can be destroyed by the minnows?

A. The moment they rise from the bed, that is, when the destruction comes; if they do not destroy them for a couple of weeks they are not going to do it.

Q. Then would it not be wise not to ship or plant the fry until they were of a proper age?

A. I never would plant the fry of the large-mouth bass, because what you call fry of the large-mouth bass are very small.

Mr. Stranahan: And there is not much loss up to the time when they become a perfect fish one and a quarter inches long?

A. No; we never ship large-mouth bass until they are nearly two weeks old.

Dr. Birge: Two weeks old means two weeks after they have begun to rise?

A. Yes.

Mr. Titcomb: If you had put the two weeks-old large-mouth bass into that pond where the minnows destroyed the product of your fifteen or twenty beds, would they then have held their own against the minnows?

A. They would. We tried that this year. In this pond I had large-mouth bass in, I had let a school come up; they were second breeding, and I had already introduced into that pond for the old fishes' benefit, several thousand minnows, and this brood came up just after we put those minnows in.

Q. That is conclusive evidence that it was safe enough to plant them at that age?

A. Yes. Most of our large-mouth bass this year we commenced planting at that age. We ship out an immense amount of what we call baby fingerlings.

Mr. Titcomb: These fish two weeks old that escape the minnows, do it by being too quick for the minnows?

A. Yes; the minnows have hard work getting them. I have watched a school of bass of that size moving along the shore, and have seen a sunfish five inches long go into that school with a vengeance and not touch one bass.

Mr. Clark: I would like to ask Mr. Lydell why he calls this a baby fingerling and this a fry?

(Mr. Clark refers to two specimens, the first specimen being small-mouth bass, twenty days old, and about one-half or three-quarters of an inch long; and the second specimen being small-mouth bass thirty-two days old, about one and a half inches long, both specimens being perfect fish).

Mr. Lydell admitted a few minutes ago that this was a perfect bass. (Indicating the smaller of the two specimens).

Mr. Lydell: It is a perfect bass.

Q. And at that age will do just as well to plant as when from three to six months old?

A. Just as well.

Q. Then why do you make the distinction—one is equally as good to plant as the other?

A. Yes, sir, the only reason that we do not plant them all at that age is because we do not get time to do it. We commence planting and plant right along as fast as we can.

Q. You call that a fry? (Referring to first specimen).

A. We do in our shipping.

Q. And call this a fingerling? (Referring to second specimen).

A. Yes.

Q. Now, from the remarks made heretofore, it is as well to plant that, because that is a fish, not a fry? (Referring to first specimen).

A. Certainly.

Dr. Birge: You ought to draw the line when they commence to say good morning. (Laughter)

Dr. Bean: I think it is a proper distinction to call it a fry up to the time when it has absorbed its yolk-sac, and then call it a fingerling. A fry, as I understand it, is a fish which has not yet absorbed its yolk-sac.

The President: Mr. Lydell suggests that the best method is to capture your stock fish in the fall and keep them in confinement during the winter in order to be domesticated. What is the best means of subsistence for fish during the winter?

Mr. Lydell: Our small-mouth bass I cannot see take a thing during the winter; they lie perfectly dormant, going into winter quarters as the pond commences to freeze up. We commence feeding the liver just after the spawning, and continue that until along in September, and then they will be fed minnows until they go into winter quarters. When our fish went into winter quarters last year you could see minnows in abundance, and they had all they wanted; and this spring when we drew the ponds out we had to seine out thousands of them and put them away until the spawning season was over.

Mr. Peabody: I would like to ask a question on this subject: As I understand, trout fry, that has come down to a commercial basis, and they are raised commercially and sold—have you any idea how much it would cost commercially to raise bass fry?

Mr. Lydell: I don't know as I could state, except in one instance, because it cost the commission fifteen great big bucks to get 262,000 of them. (Laughter) If you have a pond that is successful the cost is very small, because there is nothing to be done to your ponds in the winter, only to keep the water running.

Mr. Henry T. Root, of Providence, R. I.: It is a fact that in the eastern ponds small-mouth bass are not dormant during the winter. Under natural conditions in a pond of 2,000 acres they are not at all times dormant during the winter. We frequently catch one or two or three in a day's fishing for pickerel. On one occasion a friend of mine caught over sixty through the ice, and that shows that they do not at all times lie dormant throughout the winter—that is, that they do feed, with us.

Mr. Lydell: I never had such experience.

Mr. Titcomb: Did you see the fish?

Mr. Root: No, but I know they were caught—no question about that.

Mr. Lydell: Some men were hauled up before the court a while ago for catching black bass, by the game warden. I was out there; Mr. Palmer was there also. The trial was had and they claimed that those were small-mouth bass caught in the winter, and the man got a new trial, and I came down and found they were nothing but the large-mouth bass. I have never been able to catch small-mouth bass through the ice in winter, although I have heard of them being so caught. Some were said to have been caught through the ice at Kalamazoo, but the fish proved to be the large-mouth bass.

Dr. Bean: I can add something on the subject of black bass, because I have had them under observation in aquaria for some years at a time, and what I saw there partly corroborates Mr. Lydell's studies and partly differs from them. But we must bear in mind the fact that an aquarium is a different body of water from a pond, because the temperature is more or less under the control of the people in charge. I have seen the bass of both species take live minnows in the winter, but not often. Of course it is quite an advantage to have a fish before your eyes and to see what he does. We noted in the New York aquarium that the bass for the most part were dormant, but occasionally, whether it was because there was a little accession of temperature or not I do not know, they would rush at a live minnow and take it in just as lively a manner as at any other time during the year.

Mr. Palmer: At Jackson, Michigan, last winter, I know of twelve or fourteen arrests made for catching bass through the ice. I saw the bass and got them—and know it was done.

Mr. Lydell: Were they large or small-mouth bass?

Mr. Palmer: They were considered small-mouth, but since the trial at Three Rivers I am frank to say that I would not like to stake my reputation on it.

FOOD AND GAME FISHES OF THE ROCKY MOUNTAIN REGION.

BY DR. JAMES A. HENSHALL.

In the Rocky Mountain region there are three distinct groups of trout belonging to the *Salmo* genus: the red-throat or cut-throat, or as it is known by the United States Fish Commission, the "black-spotted trout;" the rainbow trout and the steel-head trout. They are all black-spotted. In widely separated sections of country they may be readily distinguished by certain characteristics, but in localities where they co-exist, naturally, it is sometimes difficult to distinguish one group from the others; indeed, at one time the rainbow and steel-head were pronounced by competent authorities to be the same fish, the steel-head being supposed to be the sea-run form of the species. At the present time they are held to be distinct.

The Dolly Varden, or bull trout, belongs to the genus *Salvelinus*, and is related to the brook trout of eastern waters, having also red spots. While the red-throat trout inhabits both slopes of the Rockies, the others named were originally confined to the Pacific slope.

The great lake, or Mackinaw trout, and the grayling are native to Montana. The former is found only, so far as I know, in Elk Lake at the head of the Jefferson river, while the grayling exists, naturally, only in the tributaries of the Missouri river above the Great Falls. It is worthy of remark that these two species are found nowhere else west of Lake Michigan, except in the Arctic region. It is fair to imagine that they were carried there on an ice floe during the glacial period, and it is not unlikely that both species were carried to Michigan waters by the same means, and that the Arctic grayling is the original species.

The small Rocky Mountain whitefish *(Coregonus Williamsoni)*, is abundant. It is a good game and food fish, taking the artificial fly as readily as the trouts, but is popularly not so highly esteemed. It grows to about the same size as the red-throat trout, and is, in my opinion, fully its equal for the creel or the table.

THE RED-THROAT TROUT. *(Salmo clarkii).*

The red-throat trout is the most widely distributed of all the Rocky Mountain trouts. It inhabits, naturally, both slopes of the Great Continental Divide, and as might be supposed from this extensive range it varies in external appearance more than any of the trout species. There are a dozen or more well-defined sub-species or geographical varieties, but all have the characteristic red splashes on the membrane of the throat. By means of this "trade-mark" it may be readily distinguished from the rainbow or steel-head or other trout. But while it varies considerably in contour, coloration and markings, in different localities, it is identical in structure wherever found. It was originally introduced to eastern waters as the California trout or Rocky Mountain trout, and at the present time is known as the "black-spotted" trout. The latter name is extremely unfortunate, as the rainbow and steel-head are also "black-spotted." The name red-throat trout is distinctive, and is preferable to the rather repulsive name of "cut-throat" trout by which it is also known.

The red-throat trout is commonly called the "brook trout," or "speckled Mountain trout," in the mountain region, which is also an unfortunate designation, as the eastern brook trout is now being introduced in the same waters. When it grows to a large size it is sometimes called "salmon trout," as in Yellowstone and other lakes, but the only salmon trout is the steel-head. The red-throat trout rises more freely to the fly than the eastern brook trout, though in gameness and flavor it is hardly its equal. Its habits are also somewhat different. It usually lies in pools and holes like the salmon, and does not frequent the riffles so much as the eastern trout. In size it is somewhat larger than the eastern trout in streams of the same relative width and depth, and like the eastern brook trout grows larger in lakes.

I have taken them weighing from three to five pounds in Soda Butte Lake in the Yellowstone National Park, and in Yankee Jim Canyon on the Yellowstone river. The red-throat seldom breaks water when hooked, but puts up a vigorous fight beneath the surface. As the streams are usually swift and rocky and fringed with willows and alders, the angler must be wide awake to land his fish and save his tackle. In Yellowstone Lake it is infested with the white pelican parasite, rendering many of them emaciated and lacking in game qualities; those in the river, however, are well-nourished and gamy.

THE STEEL-HEAD TROUT. *(Salmo Gairdneri).*

The steel-head, or salmon trout, is the trimmest and most graceful, and the gamiest of all the trout species, being more salmon-like in shape and appearance. Its spots are smaller than in the other black-spotted species. It has, usually, a pink flush along the lateral line, but not so pronounced as in the rainbow trout. Its color is of a lighter hue than the red-throat or rainbow, with steely reflections.

During the past five years the United States Fish Commission has introduced the steel-head in the waters of Montana, which seem to be very suitable for this fine fish. I have seen quite a number of three-year-old steel-heads taken on the fly that weighed from two to three pounds, and in some localities they have grown still larger in deeper waters, which proves that they have come to stay. Each spring we now take thousands of eggs from fish that run up our waste water ditch from the creek where we planted them five years ago.

The steel-head trout surpasses all other trout for gameness and excellence of flavor, and rises eagerly to the artificial fly. It breaks water repeatedly when hooked, like the black bass, and is very trying to light tackle.

THE RAINBOW TROUT. *(Salmo irideus).*

The rainbow trout was introduced by the United States Fish Commission in the Firehole, or perhaps the Gibbon river, in the Yellowstone Park, from whence it sometimes descends to the Madison river in Montana, and may in time reach the Gallatin and Jefferson rivers. They have since been planted in other waters in Idaho and Montana, where they have done well, some coming under my notice weighing two pounds at two years old. The rainbow is similar in appearance to the red-throat, though somewhat deeper, perhaps, and with a shorter head and smaller mouth. Its distinguishing feature, however, is the broad red band along the lateral line, common to both male and female. It is a handsome fish with rather more gameness than the red-throat trout, but not so vigorous on the rod as the steel-head trout of the same size. It grows to a larger size than the red-throat, but not so large as the steel-head.

THE GRAYLING. *(Thymallus montanus).*

Her Ladyship, the grayling, is as trim and graceful and withal as beautiful as a damsel dressed for her first ball. Her lovely iridescent colors and tall gaily-decorated dorsal fin, which might be compared to a graceful waving plume, must be seen fresh from the water to be properly appreciated. The grayling is not only a clean and handsome fish, but is as game as a trout and much better for the table. The grayling was taken in the Jefferson river a century ago by Lewis and Clark, and though they gave a fair description of it in the history of their expedition it remained unidentified until it became my good fortune a few years ago to recognize it as the grayling from the description of Captain Lewis.

While the grayling is found in the three forks of the Missouri, the Jefferson, Madison and Gallatin rivers, and in some tributaries lower down the stream and above the Great Falls, its ideal home is in the upper reaches of the Madison and Jefferson. The upper canyon of the Madison and its basin west of the Yellowstone Park is especially adapted to the grayling. There the water is swift, but unbroken, the bottom being composed of dark obsidian sand. In this region grayling of two pounds are not uncommon. The United States Fish Commission has been very successful in propagating the grayling at the Bozeman, Montana, station, and numerous waters have been stocked with this desirable game and food fish. About two million fry have been planted each season for several years in the streams contiguous to the grayling auxiliary station at Red Rock Lake at the head of the Jefferson, with the result of swarms of one, two and three year old fish. Grayling are so plentiful there that the trap can be opened for only a short time when taking spawners, otherwise they would enter in such numbers as to threaten them with suffocation.

As several million eggs have been shipped to eastern stations by the United States Fish Commission, it is to be hoped that this incomparable fish will find suitable habitations in eastern streams to delight the angler with its beauty and gameness. It rises to the fly eagerly and is as game as the trout.

DISCUSSION OF DR. HENSHALL'S PAPER.

Mr. Peabody: Dr. Henshall's paper that was read just before the noon adjournment has had no discussion at all, and there are two points I would like to have considered. Two fish are named there, the grayling and the steelhead trout that he speaks of most enthusiastically. He says that the steel head trout is the gamiest and best of the trout species of which he knows, and especially in the Rocky Mountains, and he also refers to the productivity of the grayling, and says that they are plentiful and fill the streams out there. I would like to ask some of these Michigan men who know about the grayling, if they have stopped raising grayling, and also what the experience of any other fish culturist is regarding the steelhead trout. It seems to me if they are all that the doctor claims there, and are so easily reared and got from the hatchery in Montana, that they ought to be distributed and ought to be put into Michigan and Wisconsin waters especially. The commission gave us a quantity of eggs which we hatched and put in the northern waters of Wisconsin very successfully.

Mr. Clark: I can state that the United States Fish Commission is distributing the Montana grayling in Michigan although we don't know as yet what the result is, for I do not think that any have been taken, and unless a scientific examination is made it would be difficult to tell whether they are Montana or Michigan grayling. We are planting them so far only in the principal streams that formerly contained grayling, such as the AuSable River and Pere Marquette or branches, and unless otherwise ordered by the Commission I shall continue to do so until we see some results from those streams. They are a fine fish, and we have successfully raised them at Northville. There were on exhibition at Buffalo last season some two year old Montana grayling that had been reared at Northville, and I think every one who saw them will say that they were very nice fish, and from my observation of them at that age I do not see any difference between them and the Michigan grayling. At earlier stages in their life, the first ones that we hatched, I doubted very much if they were grayling, although I do not know whether I corresponded with Washington in regard to the matter or not, but I think I spoke to Mr. Ravenel on the subject, saying that I thought the doctor had crossed them with trout, they were so spotted. Michigan grayling have no trout markings, but the Montana grayling have, and you can see them in Northville at the present time.

In regard to the steelhead trout, I will answer, so far as Michigan is concerned, that we have been planting them there for quite a while, and all those that have been caught are very large fish. One was sent to the Washington office this last winter which I think weighed seven pounds. There is one being mounted in Detroit that was caught near Traverse City that weighed twelve pounds, eight ounces; and there have been a number of other cases of this kind. The one that was forwarded to Washington I saw upon arrival. They seem to be caught in the great lake waters, or near-by, and my impression is that they are going to use Lakes Michigan, Huron and Superior, the same as they use the sea in their native country.

We have had remarkable success this year in the impregnation of the eggs, that is, getting a good quality, and I think that something like 90 per cent of good eggs were obtained from the fish, which we do not have from the rainbow trout.

Mr. Titcomb: You mean the domesticated fish?

A. Yes, sir.

Dr. Bean: I would like to say a word on Dr. Henshall's paper. The Montana grayling is not the same species as the Michigan grayling. It follows the usual rule among the graylings in that the very young have parr-marks. I do not know about the Michigan graylings. Mr. Clark has been in a much better position to learn than I, but speaking now as an ichthyologist and from book knowledge chiefly, I say that the young grayling ought to have parrmarks; the Montana grayling has them, the European species has them; the Montana grayling has a very much smaller fin than the Michigan grayling; its dorsal fin is shorter and lower; its head is smaller, and in other ways it is very easily distinguished from the Michigan grayling, so that there will be no serious difficulty in future years if the fish establishes itself in Michigan, as I hope it will, in its being identified without any difficulty, when compared with the native species.

As to the steelhead trout (for it is a trout rather than a salmon) it is a spring spawner, and care ought to be taken in the introduction of the fish. I need scarcely remind fish commissioners of that fact, but I think it is liable to be overlooked in some circumstances. It is a fish more adapted to large bodies of water than to smaller streams. If it can find its way to the great lakes or to the ocean it will grow very large—even to thirty pounds. You know a fish that will approximate thirty pounds or even fifteen pounds, is a pretty dangerous customer to have associated with brook trout and other small species, because it is a great feeder and feeds at the time the brook trout are spawning. I merely mention these facts, because I think they ought to be kept in mind in the distribution of the fish.

The President: In distribution you would distribute them in lakes rather than in streams?

Dr. Bean: Yes, sir. They run up in the streams to spawn, but prefer to live in the great bodies of water where there is plenty of food and where they can have sea room.

There was a dispute for many years about the relation of the steelhead trout to the rainbow trout, this dispute was upheld on one side by my friend Dr. Jordan and on the other side by myself and I could not quite understand why there seemed to be so much difficulty on the part of the Pacific coast ichthyologist in recognizing the difference between the steelhead and the rainbow trout. There was no trouble in my mind about it; but I learned, much to my astonishment, a few years later that they had never seen a steelhead; the fish they called the steelhead was simply the sea-run rainbow. When the steelhead at last was found it was described as a new fish.

Mr. Clark: I hate to come up against scientists like Dr. Bean on this question, for I am not able to get down to the 1-1,000 part of a pound, as the scientists are, on these things, but the Michigan grayling, as hatched by myself in 1876, and again in 1880 or 1881, certainly did not bear the parr-marks. There is another distinguishing feature or difference in the two graylings, which anybody that remembers the Michigan grayling knows. The Montana grayling hatches out and lies on the bottom, while the Michigan grayling pops out of the shell and swims like a whitefish. That is a difference that anybody will recognize; while the parr-mark is not visible on the Michigan grayling at any time.

Dr. Bean: That simply illustrates what I had in mind. I have been studying the young grayling chiefly from the books, and Mr. Clark has had the better opportunity of studying it in the field. That is where I go when I can, but when I cannot I am limited to books. The books all say that the young grayling ought to have parr-marks; the books also say that a male whitefish in the breeding season ought to have tubercles on the scales, sometimes it has and sometimes it has not. As a matter of fact, we do not know nearly all that is to be known about fish—even the wisest of us. There is a great deal more to be learned and it is to be learned from the fish themselves and not from books.

Mr. Titcomb: I was going to bring up a point which the doctor has brought up about the steelhead trout, and I think it should be emphasized as much as possible, and that is, as to the danger of introducing them into waters where you have the common trout. I should be inclined to treat them as just about as dangerous as the black bass to introduce in trout water. They are all right for our larger lakes, but I should be cautious about putting them into a lake with land-locked salmon even, but in any of our larger lakes with the lake trout it would be all right.

Dr. Birge: What do you mean by larger?

Mr. Titcomb: Not the great lakes necessarily. We have, for instance, a lake in Vermont six miles long where we are introducing steelhead trout very successfully, but that has nothing in it now but lake trout and small fish food. In Maine the commission has discontinued the distribution of steelhead trout, because almost all their waters which have not speckled trout have the land-locked salmon, which is valuable, and we cannot afford to lose them by the introduction of a new variety; and Mr. Peabody in considering that fish, should consider seriously where he puts it in Wisconsin.

The President: Would it do to put them in the same lakes with the bass, pickerel and that class of fish, armored fish?

Mr. Titcomb: That is a difficult question to answer. The land-locked salmon will do well in some lakes with bass and pickerel, but in other lakes it is impossible to have them obtain a permanent foothold. I think the steelhead trout would stand a better show with the pickerel and bass than the land-locked salmon, if they have a wide range and the waters are varied in their nature. Take, for instance, some lakes which are peculiarly shaped, irregularly shaped, with many islands, and you will find the pickerel have their own part of that lake that they will be in most of the time, and one end of the lake where they spawn, and if the small-mouth bass are in the lake you may find them in still another portion of the lake, and it is possible with some of those lakes of irregular shape to introduce either the land-locked salmon or the steelhead trout quite successfully, especially if you have good streams for them to spawn in.

The President: They will have a Latin quarter and a Polish ward, will they? (Laughter).

Mr. Clark: Do you think the steelhead more of a cannibal than the rainbow?

Mr. Titcomb: Yes, they are more predacious and more voracious, because of their size.

Dr. Bean: In the West it is a toss-up between the steelhead and rainbow trout as to destructiveness of eggs; but the Dolly Varden is the most destructive consumer of salmon eggs in the waters.

Mr. Clark: I would like to ask Mr. Seagle this question: Do you find that the rainbow trout destroy the young trout?

Mr. Seagle: I do not. I have not observed more than half a dozen cases of cannibalism in my ponds since I have been having rainbow trout, covering a period of twenty years.

Mr. Clark: Do you think they will eat fish if they can get other food?

Mr. Dean: Rainbow trout will eat each other if they can, and we have to sort them, but not as much as the speckled trout.

Mr. Seagle: We keep our trout well sorted as to sizes, and possibly that is the reason we have no cannibalism. We sort our fish at least twice a year as to sizes.

Mr. C. E. Brewster, Grand Rapids: I would like to ask Mr.

Clark if rainbow trout are dangerous to the brook trout in the brook trout streams?

Mr. Clark: That is just the point. I think Mr. Dean will remember when he was with me at Northville that we had more rainbow trout than we have now, and possibly he was there at the time the experiment was tried of putting some large rainbow trout in a tank with smaller trout, and some large brook trout later on with smaller trout. We performed such an experiment at Northville, and the large rainbow trout did not eat the smaller fish, after leaving them there four or five days or a week; but the brook trout cleaned out nearly all the smaller trout that were in the tank. I never in my life have seen a rainbow with another trout in its mouth, while, of course, we are seeing brook trout do that all the time. We take them by the tail and pull them out. Our commercial men have had the same experience.

Mr. Lane: Yes.

Mr. Clark: I have never seen the tail of a trout sticking out of a rainbow trout's mouth.

Dr. Birge: You will write him a certificate of good character?

Mr. Clark: I will so far as that is concerned. It does not seem to me that they are cannibalistic at all. But Mr. Dean says he has seen it right along.

Mr. Dean: My idea is that the water being warmer makes a difference. I know at Northville at one time we put 55,000 rainbow trout in not a very large pool, and after carrying them some time we counted out 53,000. That would show there was a very small loss, but if we leave much larger trout in the ponds with them they become cannibalistic.

Mr. Clark: I do not wish to carry the idea that they will not eat fish. Of course if you starve them to it they will do so.

Mr. Brewster: Not long ago a complaint was made that the rainbow trout in the little Manistee river (and this is the second season that they have begun taking fish from that river) were eating up the brook trout. The man who made the complaint was a gentleman who spends all his time on the river and runs a club house there. I replied to his letter expressing my doubt about the matter, and he stated that a gentleman connected with the Pere Marquette Railway Company had recently caught a two and a half pound rainbow trout with a brook trout more than six inches long in his stomach. I still expressed a doubt about the matter, and when I was up there about three or four weeks ago he showed me a number of brook trout that were badly lacerated, which showed that they had been caught by some larger fish and had been chewed up in the efforts of the larger fish to turn their prey and take it down head first; and those fish I examined very carefully, and they certainly looked to me to have been exactly as he stated: caught by some larger fish.

Mr. Titcomb: I have heard it said that the rainbow trout was responsible for the disappearance of the grayling in the Au-Sable river.

Mr. Clark: That is not the case.

Mr. Titcomb: I do not know but what I was misled in answering a question about the comparative voraciousness of rainbow and steelhead trout. I am not prepaerd to say that a rainbow trout would do as much damage as a steelhead of the same size. I had one experience with the two fish together of the same size in an aquarium four feet by two by eighteen to twenty inches high. These fish would weigh about a pound apiece. We had three or four rainbows, three or four speckled trout and one steelhead. We had to remove all the fish except the steelhead to save their lives—the steelhead was chasing them all over the aquarium and tried to drive them out of the water: he gave them no rest no matter whether they were speckled trout or rainbows.

Mr. Clark: Right in the Detroit hatchery I have in the aquaria rainbow and steelhead trout; I have seen the steelheads fight almost continuously during the spawning season, but I never saw them take down in their throat or undertake to swallow their antagonists, but they will fight viciously during that period. Was not this at the spawning season?

Mr. Titcomb: No, it was not. We have the same trouble with the rainbow trout during the spawning season.

Mr. Clark: Yes, but I have never seen them undertake to eat other fish.

Mr. Brewster: I would like to furnish Mr. Clark a brook trout from the Little Manistee that shows the marks that I have described, and would like to have him examine it and pass judgment on it.

Mr. Clark: I do not think I could tell the markings of a rainbow trout's teeth. It may have been captured by some larger fish and chewed up.

Mr. Brewster: They think it is the rainbow and I think it is, too.

Mr. Clark: Show me a rainbow trout with a brook trout in its mouth, and I will be convinced.

Mr. Brewster: I did not see that.

Dr. Bean: I have had some experience with rainbow trout both in ponds and in the aquarium; and it is very well known on Long Island that the rainbow trout is the most voracious fellow in the ponds. One bully, (and not necessarily the largest fish) will boss the whole pond or tank, and he will drive every fish away or kill them, frequently, unless they are taken away. We had that trouble in the New York aquarium. We put in some of the fine rainbows from the Long Island hatchery, obtained from the United States Commission, and they were all alike. They would fight outrageously outside of the spawning season—any time seemed to be scrapping time with them—and there was no way of keeping them alive except by taking out of the tank the fighters, and we would have to take out a new one about every day.

Mr. A. L. Coulter: I would like to ask Mr. Clark one question: I am not a fish culturist; I do not study half as closely the habits of fish as I do the habits of the violaters of the game laws of Michigan. But I find that conditions in certain portions of the country change very materially. I think Mr. Clark will agree with me that the AuSable River at one time was a grayling stream; later in its history it was a speckled trout stream; after the speckled trout was introduced the rainbow was introduced.

Mr. Clark: The rainbow trout were introduced first in the AuSable river.

Mr. Coulter: Then take the Boardman river: the facts are that wherever rainbow trout are put in different streams the speckled trout disappear and the rainbow trout predominate. You could not convince a native on those streams in a hundred years, or by all the books and technical knowledge on earth, that the rainbow trout were not destroying the speckled trout in the Michigan waters.

The President: Was the grayling driven out by another planting?

Mr. Coulter: The theory of the average mortal along those streams, who has lived all his life there and watched the disappearance of the native graylings, is that the speckled trout have destroyed the grayling, and in turn the rainbow trout is destroying the speckled trout, and you cannot convince him of anything else. I think at one time the Boardman river had some grayling in it; it was at first a native grayling stream, and the grayling was afterward replaced with speckled trout, and today you will catch about half and half, but the speckled trout are disappearing every year.

The President: I have been told by your Michigan fishermen that the grayling was a fish you could fish out more easily than you could trout; that you could go to a pool and catch every one of them; that is, they did not appear to be affected and get shy as others do, by the disappearance of their mates, but you could take the last grayling out of the pool and he would bite as eagerly as though he had not lost any of his companions.

Mr. Clark: I think that is true.

Mr. G. W. M. Brown, of Michigan: I went into the wilderness of Michigan early in 1869 and 1870 on the Pere Marquette, Baldwin Creek and Percy rivers particularly. On the first day of May, 1892, myself and a friend caught 163 grayling in one pool in the Manistee river in eighteen mile bay. That is the last day that I ever had fine fishing for grayling. The policy of the Michigan Fish Commission for the last two years has been in planting rainbow trout to put them in the larger streams where the water gets too warm for brook trout—in the Pere Marquette and the AuSable, but we do not furnish any rainbow trout for the smaller brook trout streams. For ten years I have been engaged in raising brook trout on a private, protected stream, as fine a stream as I ever saw, and the rainbow trout do not run in that stream at all; but right at the mouth of the stream last June I caught four rainbow trout that weighed eight and one-half pounds, although not a rainbow trout has been caught in that stream in the last ten years weighing a quarter of a pound. It is a comparatively small stream and cold all the time; they do not run out of the larger rivers into the smaller streams

Mr. Clark: I did not bring up this subject to defend the rainbow trout for a moment, because it is immaterial to me which fish we have. I like the brook trout personally just as well as I do the rainbow trout. The part I wished to bring out was this: I wanted to know positively whether rainbow trout fed upon other trout. Now, Mr. Brewster has spoken of the AuSable river. The records show that the rainbow trout were the first ever planted in this stream, and old Uncle Dan Fitz Hugh was the man who put them there; and everybody knows what he had to say about the grayling and what he knew about it. This latter fish was plentiful there before the brook trout came, but they never have been so numerous as the brook trout now are, and I do not believe they ever will be, right in the AuSable river. If anybody can demonstrate to me that the rainbow trout fishing is better between two or three miles above Steven's bridge and down below Wickley's bridge than it was ten years ago, I would like to know it. Mr. Dickerson doesn't find it so—as he told me. They do not get any large rainbow trout above Wakley's bridge, except in spawning season but catch them in deep water. I have seen the rainbow trout up that river in March when you wardens are not there, and have seen a five-pound rainbow trout five miles above Steven's bridge; those large fish have been caught clear to the up dam during the spawning period. When we were hauling seines and catching brook trout for propagating purposes, we captured nearly as many rainbow trout fry as we did brook trout fry; but the large fish drop down in the deeper water where you do not get any brook trout.

Mr. Brewster: I think in 1891 the first rainbow trout was taken on the Bourdman river by Winnie of Traverse City. The river at that time was pretty well stocked with native grayling, and there were some native brook trout in the stream. It had been stocked heavily with brook trout, and from that time until 1895 or 1896 the brook trout fishing was good. Now more than 50 per cent of the trout taken from that river are the rainbow trout and the brook trout are gone or are becoming scarce. There are no grayling there at this time. I do not agree with my friend

Coulter that the brook trout have destroyed them; I think other elements have conspired to destroy them.

Mr. Coulter: I did not say that at all.

Mr. Brewster: Take the Manistee river up above the log chutes, the scene of the operations of the lumbermen, and you still find grayling and sometimes pretty good fishing. I know of a party of three who caught over 100 grayling there last year. Last year at my request Mr. Clark delivered half a dozen grayling to a friend of mine in Potoskey. Those grayling have been kept and are there now. I think he lost one out of a half dozen; they are being kept in water pumped from the bay. They are doing splendidly and growing nicely, and I believe that water up there is good for the grayling.

THE ROLE OF THE LARGER AQUATIC PLANTS IN THE BIOLOGY OF FRESH WATER.

BY RAYMOND H. POND, PH. D.

The primary object of an investigation of the biology of our Great Lakes, is to ascertain the factors which determine the quantity of food fish produced. The problems at once involved in such an undertaking are numerous, but may be in a general way, assigned to three groups. In the first group we may include those arising from the various relations which the different animals sustain to each other, such as, food and feeder, enemy and friend, host and parasite, and the like, all of which are strictly animal problems to be solved by the Zoologist. In a second group, would occur such questions as are suggested by the relations existing between animals and plants, and to these, the botanists as well as the zoologists may properly give attention. In the third group, we could include inquiries concerning the relation of plants to the soil and water, and such as belong more especially to the plant physiologist. Such a grouping of the secondary problems is purely arbitrary, being given to indicate the scope of the investigation, and to lead up to the statement already emphasized by Reighard and Ward, that a knowledge of the sources of nutrition of our food fishes, involves by necessity, an exhaustive study of the cycle of matter in the lakes.

There are two ultimate sources of food for the fish, namely; soil and air. Neither the fish, nor the animals upon which they feed, can secure nourishment from these sources directly. Plants must intervene to organize the mineral salts and carbon dioxide into food for the animals. In the case of the plant plankton, we have a large amount of organic matter that may be considered as food available for animals, which themselves in turn are either directly or indrectly used as food by the fish. Thus there occurs in the lake, a manufacturing of mineral salts and carbon dioxide into plant plankton, and also, a manufacturing of plant plankton indirectly into fish. It is thus evident, that each season's catch of fish means a withdrawal of so much organic matter from the lake, and the sources of renewal of this organic matter, are manifestly important. It has long been known that water plants contain several essential food elements in greater proportion than the water, and we may say that aquatic plants concentrate within themselves nitrogen, potash, phosphoric acid. In the case of the plankton these elements must come from the water and then the plants die and are returned to solution. However, with the larger attached plants, we have another possibility, that is, they may take their mineral food from the substratum, and if they do, we have in them, agents active in the transfer of mineral food from the soil to the water. On the other hand, if the attached plants do not absorb nourishment from the soil, they must take it from the water, and their influence in this case would be to withhold during all the growing season, matter that would otherwise be available to the plant plankton.

The statement is common in all our text books of botany, even those published during the present year, that aquatic plants derive their nourishment from the water and not from the soil, that the roots are not organs of absorption as in land plants, but only holdfasts to anchor the plant. A review of the literature of this subject, shows that this statement is based upon argument and not experimental data. The anatomy of water plants has received quite a little attention in the past, and many authors have noted that the tissue systems for the conduction of water, which in land plants are so well developed, are in aquatic plants very rudimentary. Moreover, it has been observed that submerged aquatics have no evaporating surface and hence there is no necessity for an upward current in the plant. Again, the entire surface of submerged plants is permeable to water and the plant may easily secure its mineral food directly from the surrounding water. Such has been the majority opinion and argument up to the present time; but investigation now completed though as yet unpublished, proves beyond a doubt, I think, that most of our common aquatic plants are absolutely dependent upon being rooted in the soil for optimum growth, and few of them indeed can survive the growing season, if denied attachment to the soil.

To consider now some of the evidence for the latter opinion. Suppose we construct some large boxes and build a raft around the top of them so that they will float about level with the surface of the lake or slightly submerged. In some of these boxes we will make a deposit of soil six inches or more deep. This soil is to be taken from the lake bottom in some locality where there is an abundant growth of plants. In this we will plant a certain number of individuals of uniform size, of some one species that have been carefully selected from specimens growing in the lake. In the other box we will attach a like number of such plants to wooden bars, and fasten these bars so that the plants in the two boxes are in the same depth of water. We thus have for comparison, two groups of plants, one of which is surrounded by natural conditions, and the other has natural conditions except that the soil is absent, and the plants can get only such nourishment as is provided by the water. After a period of four weeks very marked differences between the two groups of plants may be noted. The plants rooted in soil look as strong and healthy as those growing in the lake. The volume of vegetation produced by the former group was twice that produced by the latter group, while the suspended plants were stunted in growth and manifested the ordinary signs of unfavorable environment. If we now collect our two groups of plants, and after carefully washing, obtain the dry weight, it will be found to be a third more for the plants rooted in soil. It is thus evident, that soil is necessary for the best growth of these plants. If now we compare equal volumes of the fresh plants in our experiment, it will appear that the dry weight of the suspended plants is greater than that of those rooted in soil. This must mean that different physiological processes have been operating in the two groups. If a microscopic examination of the fresh plants be made, it will be found that the tissues of the plants rooted in soil contain relatively little starch, while those of the suspended plants are literally gorged with starch. Thus is explained our discovery concerning the dry weight of equal volumes. It is the abnormal increase in the amount of starch, that makes the suspended plants weigh more. If now we compare the two groups with regard to their chemical composition, we shall find that the plants which were denied the soil, contain a smaller proportion of nitrogen, of potash, and of phosphoric acid. To recall now the results of this line of investigation, we may say that when the plants are not allowed to root in the soil, and are limited to the lake water for nourishment, an abnormal growth results, which is manifested by diminished volume of vegetation and total dry weight; also, by an excess of starch, and deficiency of nitrogen, potash and phosphoric acid.

Considering now the question, are the roots merely organs of attachment, or are they also for the purpose of absorption? It is not a difficult matter to separate the roots of a plant from the stem, so that solutions differing in chemical composition, may be offered to each at the same time. In this way lithium nitrate may be offered to the roots, so that the lithium, if found later by spectroscopic examination in the upper parts of the plant, may be positively known to have been absorbed by the roots and conducted upward into the stem. It is also possible to construct an apparatus by which the amount of water absorbed by a root in a given time can be measured. Both of these methods have been employed, and there can be no doubt but that the roots are organs of absorption. Moreover, the roots of most of our common aquatics develop structures, the presence of which is almost *prima facie* evidence that the organs bearing them are for absorption. These structures are the so-called root hairs, and they occur on all of our terrestrial plants, with a few exceptions. Examination has now shown that they are common also on the roots of aquatic plants. These hairs are simply ordinary root cells which are protected from the outer cell layer of the root, for the purpose of securing the maximum absorbing surface with the least expenditure of tissue.

We may next enquire, what quality of soil is best suited to support a good plant growth? Last summer here at the Hatchery, three soils were tested. One was a loam from Squaw harbor like ordinary garden soil, another was sandy with plant remains scattered through it, and the third was clayey. The same species was grown at the same time in each soil under otherwise natural conditions. The poorest growth occurred on the clay, the second best on the sandy soil, and the best on the loam. Thus is confirmed experimentally the observation made from the study of all the plant beds in the region of these islands, that other conditions being favorable, the most abundant growth of aquatic plants occurs on what would be called a good truck soil. Many of the species will maintain a growth on any of these soils and continue to reproduce each season, but it is only on the good loamy soil that the dense aquatic meadows occur.

From a study of such meadows, some of the functions hitherto assigned to aquatic plants have been established, such as protection to animals seeking refuge, a base of attachment for the growth of Algae, and even as direct food for some animals. It is in protected caves little disturbed by wave action that such meadows occur, and the aeration of the water is an important duty of the plants here. During the daytime all green plants give off oxygen as a waste of product in the manufacture of starch, and an excellent idea of what this amounts to may be obtained by observing the almost constant stream of bubbles that rise from the plants on a bright day. But perhaps the most important part played by the larger aquatic plants is the one only recently established, that of contributing to the plankton food supply. One author has recently stated that there is a direct relation between the quantity of plankton and the proportion of nitrates in the water. During each season by the changing winds and currents a large amount of plant debris is carried out into the lake from the aquatic meadows, where during the period of its slow oxidation, it is available as food for the animal plankton and when oxidized, the mineral salts taken from the soil are contributed to the water to be used by the plant plankton in organizing more animal food. It is thus apparent that in the economy of nature, water plants have the same part to play with respect to organisms of a higher order, as the terrestrial plants; that is, they are the organizers of inorganic matter for the benefit of the higher organisms dependent upon their activity.

It is quite probable that the waters poor in plankton will be found to have a small growth of the attached aquatics. Certain it is, at least, that in any explanation to account for a scarcity of plankton in a given water, the relative abundance of the aquatic plants would necessarily be considered.

Some species are much more dependent upon the soil than others. Chara and Myriophyllum are not as dependent as Vallisneria and Potamogeton perfoliatus. The two latter plants would be excellent to plant in fish ponds, because they are so dependent upon the soil and because they develop a large volume of vegetation during the growing season.

To recapitulate, we have first the facts hitherto known, that the larger aquatics are important as furnishers of shelter, as aerating agents, as a base of attachment for the growth of Algae and as direct food for some animals. Second, the fact first established in this paper, that these plants are important agents, through which the soil is made to contribute a goodly share to the food supply of the lake.

DISCUSSION OF DR. POND'S PAPER.

Dr. Birge: Was the experiment tried of raising these plants in boxes with earth and water, but with the roots removed? In the experiment described there was only one arrangement given —plants with roots and earth and plants without roots,—and with the ordinary lake water, of course. If 6 inches of earth had been placed in this box, it seems to me that a good deal of mineral salt might leach out of the earth, which the plants might have absorbed through the leaves; and I would ask, was that experiment tried, to see the difference.

Prof. Ward: I was only an observer of the experiment, but it is evident that in one respect, at least, the statement of the author has not been clearly understood. The roots were not removed from the plants, but the latter were very carefully selected, so that there should be no chance of any kind of bruising or breaking of the tissue to afford the slightest ground for supposing they were not in perfect physiological condition. The experiments were also tried in water so comparatively shallow that while there might have been a difference under the conditions which Dr. Birge mentions, I should rather imagine that there would not be. So far as I know, the exact experiment which he indicates of placing earth in the box but not in contact with the roots of the plant, was not tried. It, however, may have been, for Dr. Pond experimented very extensively and there were many experiments made of which he gave no definite report.

Mr. J. J. Stranahan, of Georgia: If the plant myriophyllum were used in a pond with poor soil and pure soft water, what would the result be?

Prof. Ward: I wish Dr. Pond were here. He experimented three or four years on this matter and he has really found some things of very great value, and I deeply regret that he cannot be here to answer such questions himself.

Dr. Birge: Have you tried it yourself?

Mr. Stranahan: Yes, but our myriophyllum does not thrive. Our soil and water is not conducive to any kind of vegetable growth.

Mr. F. N. Clark, Northville, Mich.: We frequently meet this same difficulty at our meetings, the author of the paper not being present and these questions coming up that no one can answer. I think it would be well if the Secretary would note those points and ask the author of this paper to present something on that line and perhaps others, as an addition to his paper by way of discussion.

Dr. Birge: Why not have him answer any of these questions and have them printed.

Mr. Clark: That would be well, but we always have papers where the authors are not present and most always questions come up that no one can answer.

The President: Dr. Pond might add his answers to these questions as a part of the discussion. I believe that is practicable.

Mr. Titcomb: I suggest that Mr. Stranahan relate the results of his experiments under his peculiar conditions.

Mr. Stranahan: We have made a good many experiments; we have tried all sorts of fertilizers, we have tried a compost made with cotton seed meal and with barnyard manure, and we have succeeded in making our myriophyllum and other plants grow well the first year, but they almost always die out and become absent the second year.

Dr. Birge: Even if you continue the manuring?

Mr. Stranahan: We have not continued it, because it is impossible to do it in a pond full of fish. We have also had considerable correspondence with rice planters along the coast, and find that they have never found a fertilizer which is practicable for rice which is to be flooded, which is discouraging, because vegetation is of very great importance as shown by the success had by Leary at San Marcos. But there the soil was very rich and black; the myriophyllum growing from the bottom of the pond to the top in one dense mass, in 6 or 7 feet of water; and there are more black bass produced there than at any other station of the United States Fish Commission—90,000 to 100,000 in one year.

Mr. Dwight Lydell, of Mill Creek, Mich.: I have found that the chara weed is better for pond fish than the potamogeton, as stated in the paper.

Mr. Clark: We have threshed this over each year and been in the same position ever since I have been a member of the association. At Wood's Hole we passed a resolution that all papers to be read by those in attendance should first be presented, that the papers by persons not present should be offered, and then be read as decided by the association. That resolution grew out of this very discussion that we are now in, and on your minutes of the proceedings at Wood's Hole you will find a resolution that no paper shall be read before this Society unless the author is there to read it, except by special resolution.

I wish to correct one statement of Mr. Stranahan's, where he spoke regarding the product of black bass. I do this out of respect for the superintendent of the bass hatchery at Mill Creek. The Mill Creek hatchery last year turned out over 1,000,000 bass.

Mr. Lydell: About 50,000 of those were fingerlings.

Mr. Titcomb: I hope no one here will refrain from asking any question that comes up in connection with this paper. I think if Mr. Pond is going to make an addendum to his paper for publication, he should have our views, and read our questions. It is a very important matter.

Mr. Clark: I have no objection. I simply state the resolution passed at Wood's Hole.

A SUCCESSFUL YEAR IN THE ARTIFICIAL PROPAGATION OF THE WHITEFISH.

BY FRANK N. CLARK.

As such unusual success has attended the efforts in the handling of whitefish during the past season, it is deemed that a few brief notes relative thereto would not be amiss.

The whitefish egg taking of the season just closed has been the most successful in Michigan, in the history of the United States Fish Commission. Not only has the quantity taken greatly exceeded that of any previous year, but also the quality has far surpassed that of any of the earlier efforts. This may be owing perhaps, in part, to the favorable weather conditions, improved facilities, and expert manipulation, but in the main it goes to show the wonderful results of the plants which have been made in the past in the waters of the Great Lakes.

In the collection and hatching of whitefish at the present time, two very important essentials are those of funds for carrying on the work, and then of obtaining the fish. With these two problems solved, the production of fry may be unlimited, and perhaps it might be well to state right here that of the above two mentioned factors, the former is a far more insurmountable barrier than the latter.

In the early days of the work, back in the seventies, the first successful take of whitefish eggs, with perhaps the exception of a few obtained on the Detroit River by Mr. Seth Green and my father, was made not three miles from where we are now holding this meeting. The quantity at that time, was limited to the amount obtained from the ripe fish which were found in the nets from day to day. This plan was continued for a number of years until it was discovered by experiment, that whitefish could be held in crates and pounds until ripe, thereby greatly increasing the production. This work of penning has been carried on quite extensively and with every success, on the Detroit River and at Monroe Piers, at the mouth of the Raisin River, Lake Erie.

It seems as though a no more forcible illustration of the gratifying results of the whitefish operations can be given than that of a comparison between the work of the past season and of 1896, but five years before. There was practically no difference in the methods employed, and the grounds operated were the same. In 1896 the total number of fish caught on the Detroit River was 11,263, while during the season recently completed 41,242 were taken, not far from four times the number obtained but five years previous under almost identical conditions.

Not only on the Detroit River, which is perhaps the best point on the Great Lakes for the collection of whitefish eggs, has the work been so highly successful, but at all other places where an attempt has been made the results have been the same. It is certain that the season of 1901 has been by far the best on the Great Lakes, and the records of both the United States and Canadian governments have never been equaled by the unprecedented take of upwards of 800,000,000 eggs. This large take resulted in the filling of every hatchery on the Lakes to its utmost capacity, and at one time it was thought necessary to plant a portion of the eggs on the spawning grounds. Later, however, this obstacle was overcome by holding part on trays for a short time. More auxiliary stations adjacent to the spawning grounds should be provided for the handling of the great surplus. This would do away largely with the necessity of transporting the fry for such long distances, which is not only very expensive, but at times rather detrimental to their condition. These auxiliary hatcheries will, no doubt, be provided for in the near future by the United States government.

The following account may perhaps give a fair idea of some of the details of the Detroit River work.

The collection of eggs was made from the field stations on Belle Isle and Grassy Island, the former being located in the Detriot River opposite the upper end of Detroit, and the latter about eight miles down the river below the city. The first fishing was done on the 16th of October and the work was continued until December 3rd. During this time, 2,875 hauls of the seine were made and 41,242 fish captured, an average of between fourteen and fifteen per haul, this latter being much better than usual.

Of these, 2,270 were undersized (weighing less than two pounds) and were immediately returned to the river, thus making 38,972 the number retained. They were held in crates and pounds, the former being made about twelve feet long, four feet wide, and five feet deep, of slats in order to allow free circulation of water, and the latter were of irregular size and shape, and built by driving boards into the bottom with a space between each one for free passage of water. The best day's fishing was on November 18th, when 2,568 fish were caught, and the best day's egg-taking was on November 29th, when 52,920,000 eggs were obtained. Of the fish held, 22,245 were males, and 16,727 females, and of the latter, 12,529 were stripped, the remainder being spent, plugged, or hard when operations ceased. The egg taking period extended from November 10th to December 11th, inclusive, during which time 366,040,000 eggs were forwarded to the Detroit Hatchery, thus making the average number per fish 29,215.

The number of eggs shipped to various points was 201,800,000, leaving 164,240,000 in the hatchery. As the total hatch was 135,000,000, it would appear that the percentage was a trifle above 82, but in reality it is about 85, when allowance is made for the fact that a part of the eggs shipped were eyed The season was rather earlier than usual, as the fish were hatched between March 23rd and April 16th. The distribution continued from March 30th to April 17th, and was made by means of a tug and the regular transportation cars. The latter took 27,000,000 fry in five loads, three of 5,000,000 each and two of 6,000,000 each, the former to Charlevoix and the latter to Mackinac City. The balance were deposited in the Detroit River and Lake St. Clair.

Again let me emphatically state that there has just been completed the greatest known year's work in the artificial propagation of the whitefish.

DISCUSSION OF MR. CLARK'S PAPER.

Before reading his paper Mr. Clark said: I wish to state in connection with this short paper, that our good Secretary wrote me, I think, early in January, asking me to prepare a paper—I think he said something about whitefish or something in relation to whitefish—and I wrote him that I did not believe I would have time to give him anything and did not know that I had anything new. That was the last I heard of it until the notices came out, and I saw he had me down for a paper. So I give you these few notes. It is not a paper, but a few notes on our work in connection more particularly with the whitefish. I do not want you to think you are going to get a paper.

Secretary Peabody: It seemed perfectly safe to put you down on the subject of whitefish, as being the greatest expert on that subject in the country.

Mr. Clark: I do not think so. There are many other white-fish experts in the country besides F. N. Clark.

The President: Was not the season an especially propitious one?

Mr. Clark: The water was very good, but the experience of the United States Fish Commission on the Detroit river for the three seasons we have been operating since the Michigan Fish Commission turned it over to us, is that there has not been so very much difference in that respect. I think that when the Michigan Fish Commission operated they did have three or four exceptionally severe seasons, when ice made in the river, so they could not fish. We had no trouble of that kind, and I think we are safe in anticipating a take of 300,000,000 or 400,000,000 eggs this coming season. It all depends on the temperature of the water both with the fish and eggs. I do not think it was an exceptional season. I think it was simply because Lake Erie has more fish today than it ever had before. I think Mr. Downing or Mr. Fox will bear me out in this statement judging by their work at Monroe.

The President: It is borne out by the commercial reports also, I think.

Mr. Clark: Yes, sir.

Mr. Gunckel: I never saw line fishing so good as it is out off Monroe this season. I caught with a fly one whitefish weighing eighteen and one-half pounds.

Mr. Stranahan: I would like to ask Mr. Clark, do you think there are more whitefish in the lake than there ever was, away back in the early days of fishing?

Mr. Clark: I do not mean to be understood as saying that. I mean that the increased catch of whitefish in Lake Erie is wholly due to the propagation and planting of fish in the Detroit river and Lake Erie. I say it boldly because there is less protection to the whitefish in Lake Erie and the Detroit river. So, if it is not from our work, what is it from? The catch has increased each year gradually from 12,000 until now we are expecting to take 50,000 fish this fall on the Detroit river.

The President: That is the testimony of all of the fishermen along our shores, that the depletion caused by the fine nets, etc., has been arrested.

Mr. S. W. Downing, of Put-in-Bay: I would like to bear Mr. Clark out in his last assertion, that the increase is undoubtedly due to the propagation of the fish. We have steadily increased in the number of eggs taken. Two years ago 235,000,000 eggs were taken at Put-in-Bay. Next season 194,000,000, last season 335,000,000 eggs were taken. That in connection with Mr. Clark's station would make the total something over 700,000,000; and there is no question but what it is coming from the artificial hatching of the fish. We put out from this station alone this spring a little over 200,000,000 fry. Our total hatch was 81.8 per cent. Mr. Clark beat me about 3 per cent on his hatch.

Mr. Clark: Another fact bears out the results of our work. They seldom used to catch any small fish—that is, what we call underweight fish, those under two pounds. A year ago last fall we caught a little over 6,000, and last season over 2,000. Now, ten or fifteen years previous to that, no mention was made of the small fish, there not being enough to attract attention.

Mr. Lydell: It has been about fourteen years since I commenced taking charge of some of the river work, and at that time we had between 250 and 300 jars in the Detroit hatchery, and ran seven fishing grounds to fill those jars with eggs; and now we have 1,035 jars and three fishing grounds are sufficient to fill them—and more too. Last year I think we also filled the Duluth house and the Soo house and all the houses of the United States Fish Commission, easily, with three grounds.

Dr. T. H. Bean: (Formerly of the United States Fish Commission, now of the World's Fair at St. Louis). It has seemed to me that there was a little skepticism about the remark by my friend Gunckel about whitefish being caught on a hook, and I thought perhaps it would be interesting to state something that has occurred in my own experience in keeping whitefish in aquaria. There is a whitefish which you know has been called the Labrador whitefish, but which I cannot distinguish by any essential characters from the common whitefish of the great lakes. All the characteristics that have been assigned to them by ichthyological writers prove to be transitory or non-existent, and for that reason I still hold to the opinion expressed a few years ago, that the Labrador whitefish and the common whitefish are the same species.

Now, it has been supposed, I think very generally, that that form of whitefish with the small mouth and the lower jaw shorter than the upper will not take the hook and will not take live bait. In the aquarium of New York City in 1897 we had a lot of so-called Labrador whitefish from Canandaigua lake. They were fed upon small fresh water shrimp, which were shipped from Caledonia and other parts of the state. They fed very readily upon them, but after a time it was difficult to obtain that food, and then we began putting into the tanks small salt water minnows, or mummichogs (killifish), and in a very little while the Labrador whitefish were rising to them and taking them the same as the trout did, and they continued to feed on them for months at a time.

And another fact, in Canandaigua lake, fishermen catch those same whitefish on baited hooks.

I saw a little item in *Forest & Stream,* by a Canadian member of the Fishery Commission, to the effect that the new whitefish, which evidently is closely related to the common whitefish, and I think Dr. Smith has identified it as Richardson's whitefish, is known up there to take the hook, and is so caught. I say this in defense of my friend Commodore Gunckel, and as a matter of some interest, because I do not think it is generally known that the common whitefish will take the hook.

Mr. Clark: I believe that Dr. Gunckel thought I would not smile when he spoke of catching the eighteen pound whitefish with a fly. I want to say that whitefish weighing two and one-half or three pounds, which have been raised in our ponds, take flies from the top of the water.

The President: That is the natural fly that lights on the water?

Mr. Clark: Yes, sir.

Mr. Gunckel: In looking over my records I find I did not wear my glasses when I made my first statement. The fish that I actually caught at the mouth of the river Raisin was a common carp. (Laughter). But Judge Potter, for many years a fish commissioner of the state of Ohio, told me probably twenty times of the whitefish that he had caught off Nipegon—I have forgotten the bait that he used—and I know when I go to Crystal Lake in the northern part of Michigan, of some Indians who come from Frankfort to sell whitefish (and I believe there are more whitefish to the square foot in that lake than in any lake Mr. Clark has in Michigan), and they catch them with hook and line. They bring in fifteen or twenty whitefish nearly every summer that I go up there to fish. They must bite with hook and line. All the propagation that you talk about leans toward the commercial interests. About three-quarters of the gentlemen present represent the angling fraternity of which I am a proud member. I believe I belong to some fourteen different angling clubs and societies in the United States—always have and I am now growing old in the business and have the reputation of being the biggest liar in the United States, and so am entitled to recognition.

Mr. Titcomb: To substantiate Dr. Gunckel's remarks—

Mr. Gunckel: Don't get that "Doctor."

Mr. Titcomb: I want to say that in Lake Winnepiseogee the whitefish is commonly taken with hook and line; and in further substantiation of Dr. Gunckel's remark about this particular whitefish which weighed so much, he took me aside here today and told me about it, but explained that he not only had a baited hook, but had a bated breath. (Laughter).

Mr. W. A. Palmer, Buchanan, Mich.: I would like to ask Mr. Clark to what he attributes absence of whitefish about Michigan City, St. Joe and Grand Haven, where they used to be so plenty?

Mr. Clark: Fishermen. I think there have been without question millions upon millions of small fish caught in Lake Michigan and other lakes—not so many in Lake Erie, because they cannot get them. In Lake Michigan however, there has been just as much fishing as in Lake Erie, while the former has not been anywhere near so heavily planted, therefore to furnish its quota many of the fish have been under weight. The fishermen being after every one they can get, regardless of its size, and consequently the fish are being greatly reduced in numbers in Lake Michigan. I think if we could plant fry in Lake Michigan as we are doing in Lake Erie and Detroit river, you would see in the course of five to fifteen years, a great increase in the Lake Michigan output. Lake Erie and the Detroit river have had at least one-half of all the fry that have been hatched on the great lakes.

Mr. Palmer: In other words, Lake Michigan and that vicinity have not had any fry there.

Mr. Clark: Oh, no, I do not say that. They have had quite a good plant every year. This year we put in Lake Michigan about 30,000,000, and I think very likely Wisconsin must have put in 20,000,000 or more.

The President: We did.

Mr. Clark: But 50,000,000 fry is not enough for Lake Michigan. We should have 500,000,000.

The President: I would like to ask, is the whitefish a migratory fish, or does he stay in the vicinity of his birth place, or where he is planted. Do they rove around and colonize other parts of the lake, or are they local?

Mr. Clark: I cannot answer that question. I have been connected with whitefish work for thirty years, and that is a question that I cannot answer you. Perhaps our scientific men can, but I cannot; however I can say that the whitefish are in the Detroit river in the fall and I know that they are not there in the spring, but whether they go a long distance or not I am unable to tell. We do not get, or we did not used to get, the same colored fish in Lake Huron that we do in Lake Erie and the Detroit river. I hardly think they ever go up through the St. Clair river into Lake Huron, but still I cannot answer those questions.

Mr. Palmer: A large quantity of whitefish were caught this season in the vicinity of Charlevoix, while at South Huron, formerly one of the best fishing grounds, there have not been any.

Mr. Clark: I can say in answer that for a term of years the United States Fish Commission have not planted any whitefish in Lake Michigan below Frankfort, and our reason for it is that we do not believe the whitefish spawn below that point. We do not know for certain, but are waiting for the Scientific Bureau to make investigation. The only way we have of knowing where whitefish spawn is by looking the fish over that are caught by the fishermen at such points, and I do not think there have ever been any eggs taken from south of a point near Frankfort across the lake. Years ago we used to send men to St. Joseph, Michigan City, and I think one year I had some men over on the other side near Waukegan; but we never were able to get any ripe fish there, and that is the only way we know as to whether or not they are spawning at that point. I think that after we have our scientists do some dredging and working on that line, they will be able to tell us. I believe I have stated that we do not know where the spawning grounds are. As long as we have taken eggs off Alpena, ever since 1880, we get ripe fish at certain points, but I am here to say that I do not know that that is the spawning ground, because there have never been any eggs taken up from the bottom.

Dr. Birge: That would indicate a very considerable distance of migration. Whitefish are caught all through the southern end of Lake Michigan and the schools must have migrated 80 or 100 miles there, if the fish did not spawn south of Frankfort.

Mr. Clark: I would not call 80 miles a great migration.

Dr. Birge: I would not think so either.

Mr. Clark: When we have this biological station some of these questions will be settled, and I do not expect to see this problem decided until a thorough investigation on that line is made and this is what the practical fish culturists on our great lakes are waiting for—something along that line—and our scientists must start it.

Prof. Reighard: I may, perhaps, throw a little light on the question of the existence of local races of whitefish: Last summer the United States Fish Commission sent a man to Lake Erie to study the local races of whitefish, and he worked at several places on Lake Erie, by the statistical method, making very accurate measurements and determinations of color of whitefish in different regions, but was unable to find any local differences. Now, in the case of some of the marine fishes, those local differences are very noticeable, and by making such studies it is possible to locate local races. The whitefish spawn in the western end of the lake in the fall, and that would obliterate local races by interbreeding.

On the other hand, this same man, Dr. Raymond Pearl, has gone this year to the northern end of Lake Michigan and is at Charlevoix now. He has been measuring the whitefish there and he finds very distinct evidences that they form a different race. This race is very markedly different in its measurements from that of Lake Erie. Of course that is nothing more than the fishermen have said for many years, that they could tell Lake Erie whitefish from Lake Michigan whitefish, but so far as scientific evidence goes it is all there is, I think.

The President: Is there not a whitefish called a bluefish?

Mr. Clark: Yes, sir, but that is not the fish under discussion.

I would like to ask Prof. Reighard whether his investigator at Charlevoix has examined a sufficient number of specimens to know whether he may not have had some fish that were planted there and had increased in size.

Prof. Reighard: That was one of the things had in mind in sending him up there, but as far as I can learn he has no evidence on that point. It ought to be possible to find by this method trace of Lake Erie whitefish planted up there, but he has not got them yet. That may come out when he reaches the final discussion of his results.

Mr. Clark: This could lead into a great many questions we would like to ask, but I do not know as we ought to take up the time.

The President: It is a very interesting topic to us who are situated on the great lakes.

THE BROOK TROUT DISEASE AND CEMENT PONDS.

BY M. C. MARSH.

At the preceding meeting of this society, in some remarks on the brook trout disease, you may remember that it was pronounced to be probably bacterial, but that this had not been definitely established by the usual process applicable in such cases. Since that time experiments on healthy trout at Northville have furnished substantial proof of its bacterial nature. It is not necessary to go into these in detail here save to say that they consisted of a series of inoculations into healthy trout of pure cultures of bacteria taken from the blood of diseased trout. Such inoculated trout developed the same symptoms and lesions as those which had contracted the disease in the natural way, and like them, they died. The experiments were controlled by duplicate lots of healthy trout which were kept in the same water and fed the same food as the others, and under identical conditions save that they were not inoculated with the cultures. There was no loss among these latter trout. The bacterial organism used in these inoculations is now regarded as the cause of the brook trout disease.

Cement ponds were proposed as a rational method of preventing this trouble with the brook trout. It was held that the germs of disease menaced the trout in small ponds from two sources,—the immediate surroundings of the pond, and the water supply. Just what the relative importance of these two sources was could not be stated with certainty at that time, but there were reasonable grounds for believing that the former—the linings of the ponds and the earth about them—was the greater of the two, and that if this danger were removed that the disease might be prevented. The cement ponds were directed against the one source of infection alone—the localized or secondary source—and could not protect against any infection which might flow down with the water supply. There seemed to be a reasonable chance that danger from the water supply was not great enough to cause the epidemic every year, largely because the fry in the troughs had seldom had the disease. Accordingly, two of these ponds were built last fall at the Northville Station of the United States Fish Commission. They had a foundation of concrete and a superficial layer of cement on sides and bottom, so that they were solid throughout and impervious. Nothing could enter these ponds through the construction itself, but must come by way of the water supply or directly from above. They were stocked with brook trout without suspicion of disease, some from the Au Sable River, secured by permission of the Michigan Fish Commission, the rest from the trout farm of Mr. Hansen, at Osceola, Wis.

We have now had nearly a year's experience with these ponds. They have failed to prevent the disease. Most of the trout thrived in a promising way until January, when they commenced to die. The dead had the suspicious marks or lesions of the disease and from the blood pure cultures were obtained of the same organism that had previously been found in the diseased trout, before the cement ponds were built. It is the same disease recurring. The Au Sable trout began to die very soon after they were placed in the cement ponds. Now, a large per cent of the Au Sable fish had sustained injuries chiefly of one sort, a bruised snout from contact with the crates in which they were temporarily held. The injured snout is an open door for the entrance of micro-organisms into the blood. The protecting skin is broken, the tissue beneath is left raw and a bacterium drifting against this exposed surface finds an easy lodgment and nourishment of exactly the sort adapted to it. It immediately begins to multiply and is carried into the circulation and finally brings about the death of the trout. The rule may be laid down then that trout with the skin intact have the best chance of resisting the initial attack and that those with wounds of any kind can be placed in infected waters only with fatal results. The other trout were uninjured fish and they resisted the disease for some months or until the organisms had time to make their way through more minute wounds which doubtless all fish receive in the natural course of their existence, or by way of the intestinal tract having been taken in when feeding; or they may possibly have penetrated slowly the unbroken tissues.

The cement ponds are, then, if this one year's trial is a reliable index, as it probably is, a failure as far as their main purpose is concerned, prevention of this disease. They demonstrate this fact very clearly—that they are insufficient to deal with it as exemplified at the Northville Station, and in so doing they make a valuable contribution to knowledge of this disease, and an important step is taken in attempts at prevention. For the idea of excluding infection by an impervious construction followed naturally from the nature of the disease and was one of the very few practicable means of dealing with the problem. The ponds accomplished this exclusion, for they have withstood the severity of winter and are practically intact. They have protected the trout from infection contained in the earth about the pond and this being insufficient the conclusion is forced that the water itself brings into the pond the bacteria of disease and that the springs that supply the station are their source. That these bacteria arise in the springs is a matter of very serious import. It throws the origin of disease back to a source over which we have no control. It is impossible to disinfect these springs. Disinfection can occur only in the superficial layer of the bottom while fresh infection is constantly arising from the depths. The water cannot be filtered to a germ free condition on the necessary scale for practical operations. The infection cannot be dug out. It is a natural attribute of the supply springs and I do not see any means of dealing with it which allows brook trout culture on the present intensive plan, i. e., many fish in a small space, and at stations with infected water.

This does not compel the abandonment of the brook trout at such stations, however; at least, not as yet. The next thing to be recommended is culture in comparatively large natural ponds. The chief advantage gained is the increase of space, diluting the infection and separating the fish. The more natural conditions, aside from space, doubtless have their influence also. There is some past experience favorable enough to justify such a pond. Mr. R. S. Johnson of the United States Fish Commission has checked the disease in this way at his station at Manchester, Iowa. It may be considered a sort of compromise with the disease because even if continuously successful, it cannot be expected to produce as many trout to a given outlay of space as the small pond system. It cannot eradicate all the conditions that cause the disease, and it is possible, even probable, that with continued use this large pond will lose such efficacy as it possesses. This is a matter for experience to settle. Some of the old ponds at Northville will probably be replaced by excavating a large basin which shall be fed with cold spring water and contain natural vegetation. It will be stocked with brook trout and the round of fish cultural operations which involves the use of ponds will be conducted in it. It is expected to reduce materially the losses from disease, but whether as a permanent system it will give satisfactory returns remains to be seen.

The question of the value of cement ponds as a construction for small ponds in general, aside from any question of disease, will I hope be tried out by the experience of the fish culturist. I think they have made a favorable impression at the outset and possibly continued use may show that their greater durability, cleanliness, and sightliness, will more than compensate their greater initial cost.

DISCUSSION OF MR. MARSH'S PAPER.

Dr. Birge: I should be glad if Prof. Marsh would say a little as to the nature of the organism he describes, as to whether it is a baccillus or a coccus.

Mr. Marsh: It appears as every form that a bacterium takes, and when one sees it under the microscope in the tissues it is plainly a bacillus; but when you isolate it on solid media outside of the fish it is plainly a coccus, and yet it is the same thing.

Dr. Birge: How is it in liquid media?

Mr. Marsh: It is intermediate, a short rod.

Q. Does it form spores?

A. No, it does not.

Q. Have you succeeded at all in finding it in the water?

A. That is what I have been attempting to learn during my last trip to Northville. I have been there about a week, but have not got it yet.

Q. Does it form a characteristic growth on plates?

A. Yes, it does. The colony resembles a number of other water organisms and is not so strongly characterized that you can readily tell it from these.

Q. Does it liquify?

A. It liquifies rapidly.

Q. Has any disease of fish previous to this case been traced definitely to bacteria?

A. Well, in Europe several bacteria have been described as coming from fishes.

Dr. Birge: I know that.

Mr. Marsh: But the organism has not been proved to be the cause of the disease. They merely mention it in that way. I really do not know of any case where this relation has been established, but you see, very little work has been done in that direction.

Dr. Birge: There was a time when I knew something about this general line of subjects, but since I have been engaged almost exclusively in executive work during the last four or five years, I have not kept so closely in touch with this work as I should have liked to do. Those who look at these matters from a practical rather than a scientific point of view, ought to appreciate that this work of Prof. Marsh's is of very great scientific interest. Although a vast number of water bacteria have been described, yet very few, if any, diseases of water animals have been shown to be attributable to such bacteria. Indeed when I used to keep up with the literature, the statement used to be made that there were no pathogenic water bacteria affecting water animals, although there were some pathogenic bacteria that could live in water for a certain length of time, but that none of the various diseases that affect fish and other fresh water animals were due to bacteria. On the other hand, that there were many diseases due to the coccidia, a totally different group of organisms, belonging, probably, to the animal side. It is quite a triumph for American science to have demonstrated so conclusively as Prof. Marsh has done, the relation between this important disease and bacteria. It is a hopeless kind of thing, however from the practical side, apparently, to demonstrate, because it seems impossible for us to do anything either to ward off the attack or, I suspect, to cure it after it is started.

Prof. Marsh: I have no hope whatever of a cure, although a year ago we tried formalin, but it was of no use.

Dr. Birge: How far are the springs in this case from the pond?

Prof. Marsh: Mr. Clark, I think, will tell you the exact distance. It is a few rods, I think.

Dr. Birge: You speak of these organisms as being in the springs. They ought not to be in the spring water, as it comes out of the ground.

Mr. Clark: The springs that Prof. Marsh has spoken of flow into the ponds, I should say, about 90 or 95 feet from the source; but from the upper or main spring it is probably 300 to 350 feet or a little further to the ponds. The water runs in a sort of an open, paved ditch and through one series of ponds. In another series it comes down through a pipe into a little pond and then passes underground, these two being all that are supplied from the main spring. Mr. Marsh's cultures are being made from waters of both springs.

Mr. Marsh: When Dr. Birge speaks of its being strange that bacteria should come from the water as the water comes from the ground, it does seem rather peculiar; but that must be the case, because the fry in the hatchery in the troughs now have the disease, or take it, or have had it; and one can hardly imagine how they could get it from the trough, and I do not think there is any infection introduced on the way from the spring to the trough. Whenever any trout are put in these spring waters they take the disease, and the spring water itself, as it comes from the ground, is much more to be suspected than the conduits through which it is carried.

Dr. Birge: I have no doubt that the bacteria are in the spring hole, but that they are in the water as it comes out of the ground seems remarkable.

Mr. Marsh: I go as far as that, too. The bacteria are localized in the spring and the only source of infection appears to be the ground. We disinfected the spring so thoroughly with chloride of lime that it looked as though we had killed everything in it, but the disinfection did not improve the remarkable condition.

Mr. Clark: But it pretty near killed some cattle several miles away.

Dr. Birge: The logical conclusion from that statement is that the baccillus is apparently tougher than a cow. (Laughter).

Mr. Marsh: It is strange, for if the infection comes from the water why is it not more widespread and why does it not appear in all springs? My idea is that it is a freak of nature and a condition that we must simply accept.

Mr. Clark: I would mention one thing, perhaps, for Dr. Birge's information that Prof. Marsh did not state: The spring that is flowing entirely into the cement pond does not touch the air until it reaches this pond where the trouble exists. It commences under the northwest corner of our new hatchery and flows under the wall, through tile, and comes out near the lower corner of the building in a crock and iron pipe; it is all underground until entering this pond, and is the only source of water to it. The pond is impervious no water being able to enter through the sides or bottom. We even went so far as to tile-drain a little spring away that is under the cement.

Dr. Birge: It is entirely possible that the bacteria should have been introduced in these troughs. You say some trout began to die very soon after the water was introduced through them.

Prof. Marsh: Yes. That was on account of the injured snouts of the fish mentioned in my paper, which rendered the fish liable to infection from any pathogenic organisms with which the abraded surface came in contact.

Dr. Birge: How were those trout transported to the spring, to your hatchery?

Prof. Marsh: In the fish cans ordinarily used for that purpose.

Q. Could not the germ have been in those cans. Had not those cans been used where they could get the germ?

A. I do not know where they had been.

Q. Was the possibility of infection there absolutely excluded?

A. No, it was not. It could not be excluded. Those cans are a possible source of infection. There were other fish brought from Osceola in ordinary fish cans; and it was a hard trip. They are the ones which lived until the winter; but they were not injured.

Dr. Birge: What you say of the injury is perfectly reasonable; that that was the cause of the rapid death of the fish. In that case one fish infected from the can would infect the entire pond.

Prof. Marsh: The can is a possible source of infection.

Dr. Birge: But not a probable one?

A. No, because the cans are used constantly for that purpose without producing infection.

Q. You had the disease there before the fish were transported?

A. Yes, but not in these cement ponds, of course.

Mr. Clark: There is one point that Prof. Marsh did not bring up. The fry that died in the troughs last spring when he was there were receiving water from the upper spring that had never had a fish in it up to that time—later we put some in it—but up to the time the fry commenced dying in the troughs in the house, the water came from the upper spring, which never, in all of its twenty-six years had had a trout in it.

The President: What was the percentage for mortality in the trough?

Mr. Marsh: They all died, except sometimes there was a little remainder that we called immune, but a very small per cent of the whole—I cannot say just what, but not over from 1 to 5 per cent—they practically all died.

Mr. Clark: There is one point in this matter that bothers me. Prof. Marsh has now almost come to the conclusion that this infection of bacteria is in the water as it comes out of the ground. Now, if that is a fact why was it not there and why did not this peculiar disease affect our trout before a certain time, not more than two years ago? Why have we not had some of it during the whole twenty-four years previous to that time? When we did have diseased trout (and we had an epidemic once before when Prof. Gurley was there) it was not pronounced to be the same disease.

Mr. Marsh: I cannot explain why it was there many years ago, but it may be compared to volcanoes which erupt intermittently. I think it is just some natural change in the earth below which brings this organism into the water. It is some change in the constituents of the water—that is the only explanation I can make of the infection starting up as it did.

Dr. Birge: Is not there another possible explanation of it?

There are quite a number of bacteria just on the edge of being pathogenic and which are ordinarily not pathogenic. That is true of the colon bacillus. You get a particularly virulent group of them and they will cause disease, while under other conditions they do no harm; and it is perfectly conceivable that you have got a pathogenic form of a bacillus which is ordinarily not pathogenic; and then it is also possible that the resisting power of the fish has been somewhat diminished; so that it may be both of those conditions or either of them in combination which has caused the infection.

Prof. Marsh: Do I understand you to mean that this organism may have been there all the time?

Dr. Birge: If it is a water organism I should conjecture that it has been there all the time.

Prof. Marsh: Yes, but it has changed its habit—that is a very reasonable supposition, but one can never find out about it, to a certainty.

Dr. Birge: If you find this organism in the water it may be entirely possible for you to find it in the water of other hatcheries, but not developing in a pathogenic way.

Prof. Marsh: Yes.

Dr. Birge: If you get it in the water here I think you ought to look for it where the disease is not known.

Prof. Marsh: You mean attempt to find a harmless form of it somewhere else.

Dr. Birge: Yes.

Mr. Lydell: Was there any vegetation in those springs previous to this disease appearing there?

Mr. Clark: Yes, all of our water there will grow vegetation, principally of a certain kind of moss, but there is not any great quantity.

The President: Would it form a scum on the top if allowed to remain?

Mr. Clark: Oh, no sir, nothing of that kind—it is a growing vegetation of a limy nature, that is cleaned out from time to time.

INBREEDING POND-REARED TROUT.

BY ARTHUR SYKES.

In submitting this paper the writer does not profess to speak with authority on the subject under consideration nor desire to pose as a discoverer or a pioneer. If it should appear that the subject is already well understood and so simple as to be unworthy of consideration here, an apology for the writer may, perhaps, be found in the fact that he has never heard the subject discussed in any of its phases in relation to fish culture or read anything on the subject emanating from fish culturists in any journal or report, not excepting the reports of the American Fisheries Society. Much has been said and written about methods and results of propagation; but little thought, it seems, has been given to the foundation on which we work or the quality of the material of which it is composed, i. e., the potency and vigor of the parent fish and the embryo.

So far as the writer has been able to ascertain the principles underlying the breeding of domestic animals, here exploited, have not been applied in fish culture excepting in a very limited way; and no fish culturist has put those principles to a practical and complete test. If, however, my knowledge of what has or is being done is not complete or my surmises not entirely correct, it is hoped that the attention now called to the subject may be of use to some breeder; and that a thorough discussion of the subject by the Society may be had for the benefit of those who, like the writer, confess to a mediocre knowledge of an important subject while willing to contribute his mite.

The first stock for the pond culture of trout was doubtless obtained from waters in which the fish was found in its primitive state. It was with this stock that the protected propagation of trout in ponds on a large scale was begun. The method of breeding pursued, which is still in general practice, is as follows: The spawn is taken from the female fish of the breeding stock, large and small indiscriminately. The eggs thus taken are fertilized with milt obtained from the male fish of the stock with the same lack of regard as to the size, vigor and color of the fish. In this process, I repeat, little or no attention is paid to the size, vigor, or color of the fish spawned. Everything is threshed out, so to speak, that will produce eggs and everything is stripped that will produce milt.

The eggs thus taken are laid down in hatching troughs and incubated. The first of the season's crop of fry is usually saved for the use of the hatchery to increase and replenish the breeding stock in the ponds. The remainder of the crop is sold by the private hatchery or planted in public streams by the state hatchery as the case may be. The fry saved for the use of the hatchery is transferred to ponds, and here protected from enemies without, and as far as possible from cannibalism within. This system has been called protected propagation, and very properly, for you will note that unlike their brook-reared cousins, they are protected from beginning to end.

In saving the first of the season's crop for the hatchery ponds the fish culturist, or many of them at least, take the first of two steps in practice toward keeping the stock of trout in their ponds from deteriorating in quality, size and color. The second step consists of purchasing from time to time a few thousand eggs or fry from some other hatchery where the fish are bred in exactly the same haphazard way as a rule.

The first of the season's crop of fry is saved as it is found to be stronger, larger and perhaps more hardy than the fry hatched later. The early hatched fry usually comes from the older fish, hence has not been inbred as much as that hatched later. Fry is purchased from other hatcheries for the infusion of new blood in the breeding stock. This, with some variation in individual cases, is, in a general way, the system of trout breeding in vogue.

The results of this system of breeding under the writer's observation are, that the fish deteriorate in color, size, vigor and productiveness. A considerable number of barren fish are found. The markings of the fish are variable and indistinct, and the color of the flesh changes from pink to white.

It is possible, perhaps probable, that all the defects noted here in pond cultured trout are not due to what I consider a loose system of breeding; but it has been established almost beyond doubt that deterioration along the lines mentioned takes place in breeding domestic fowl, animals and plants under a similar haphazard system: and I deem it fair to assume that if we get similar results from a similar system that the same causes have produced those results.

Sir James Gibson-Maitland, Scotland's greatest fish culturist, in speaking against the introduction of foreign trout into the streams of Scotland said, "Civilization must breed its trout as its cattle, or civilization will have no trout." The truth of this statement is evident to me, though I have no doubt he wrought better than he knew.

The ordinary breeder of domestic animals considers it necessary to introduce new blood into his yards from time to time by selecting a male to breed to his stock. In making this selection he does not choose a scrawny, undersized specimen, but obtains the best his means and other circumstances permit. He saves the best specimens of his flock to mate to the male thus selected, and in this way he prevents degeneration of his stock and perhaps increases their size and usefulness.

The fish culturist does not as a rule make a selection of his stock with a view to increasing the size and hence the usefulness of the individuals. His matings are haphazard and the results of a corresponding nature. It is true that he introduces new blood into his ponds, but of what avail is such new blood if it is of the same quality as the old?

The careful and precise breeder of domestic animals selects and breeds his stock to the end that he may improve them, and to perpetuate the good qualities in the offspring from generation to generation; but the system practiced by the trout culturist has for its only object the perpetuity of the species, and the results indicate that he would ultimately fail even in this.

Among wild birds and animals, and I may say fishes, the law of natural selection operates to insure indefinitely the continued existence of the species until the environment changes in such manner as to cut off its existence without regard to the natural laws of breeding. In their primeval state, there is no question but birds, animals and fishes inbreed closely; but the laws of nature operate in such manner that only the strongest and most vigorous of the offspring survive and reproduce. The weaklings are destroyed by the inclemencies of the weather or their natural enemies.

The markings of the individuals of the same sex in most species do not vary under the same environment in the wild state. It is claimed that a dozen quail of the same sex taken from as many different localities in the United States would show little or no variation in the markings of their plumage; and the species does not perceptibly vary in size at maturity. It is probable that if a single pair of strong vigorous quail were again released as in the time of Noah and were to multiply and their progeny live through centuries in fields constantly rich with food, yet so surrounded with natural enemies and subject to such conditions as would tend to cut off the weaklings of the progeny, they would increase in size as a species; and notwithstanding inbreeding would be perpetuated indefinitely. If the food supply was insufficient doubtless the species would decline in size. If no conditions prevailed to cut off the weaklings and inbreeding occurred for any extended period, the species would dwindle away.

Nature's laws provide for the indefinite existence of the species and the environment largely determines its physical characteristics.

The breeder of domestic animals and fowl conforms to Nature's laws by permitting only the largest, strongest and most vigorous of his flock to reproduce. He fixes the environment in such manner that the desired size is insured and thus maintains or increases their size as a whole or a species from generation to generation. He may inbreed closely for many years, perhaps indefinitely, yet by careful selection not impair the size or vigor of the individuals of his flock; but on the contrary most certainly add to their beauty and their usefulness. In like manner, the fish culturist can in my opinion, by careful selection of his breeding stock produce a fish of uniform markings, of larger size, of increased vigor and greater beauty and usefulness.

I have no doubt but many practical men will regard as visionary and impractical the theories here advanced when applied to fish culture in ponds; but with some knowledge of breeding of domestic animals, after eleven years of service at a trout hatchery and much of this time given to the practical workings thereof, the writer is convinced that these theories can be applied in the pond culture of trout and that they will mean something when so applied. They will mean that the trout in our ponds will be more vigorous and healthy: that they will be larger; that they will produce more spawn; that a larger per cent of the spawn will hatch; that a larger per cent of the fry will live; that the output of the hatcheries will be increased; that more trout will be planted in our public streams; and that larger and handsomer trout and more of them will be taken from those streams with greater delight and satisfaction to the fisherman.

The system of breeding which I have sketched here would entail but little extra expense or trouble on the trout culturist. The only additional apparatus needed in the usual outfit for taking spawn at a hatchery would be an extra tank to hold a few of the finest specimens found in the ponds.

The usual procedure in taking spawn at a trout hatchery is to confine the fish to a spawning pen or raceway and with a dip net transfer a few at a time to a tub containing some water, from whence they are handled by the spawn takers. The extra tank mentioned should be located near by and supplied with water, and whenever the spawn takers find a nice specimen of either sex, strong in size, color and markings, such specimen should be transferred to the tank mentioned. After the regular stock of breeding trout has been handled over, the eggs may be taken from the fish in the tank and fertilized by the best males saved for the purpose; and the eggs thus obtained should be given a separate place in the hatchery. The fry from these eggs should be kept separate and finally transferred to the hatchery ponds to form a part of the hatchery breeding stock. No other fry should be saved for breeding purposes.

When it is thought desirable to introduce new blood, this should be done by obtaining a number of mature specimens of good size, color, etc., to be used in connection with the selected breeders from the home stock rather than by purchasing a large quantity of fry or eggs bred in the usual way.

The mature fish selected for the introduction of new blood may or may not be wild fish. If the progeny is to be planted in wild, unprotected streams, wild fish would be preferable for this purpose; but in either case the specimens selected should be of good size, color and markings.

I am convinced that the law of "Like begets like" applies in the same manner and to the same extent in the propagation of fish that it does in breeding domestic animals; and if it is desirable and profitable that only the fittest be selected in breeding in the one case, it is just as desirable and just as necessary that such selection be made in the other.

We should aim to improve the quality of the fish in our ponds and through them the quality of the fish planted in the streams. That there is room for improvement here is indicated by the fact that many expert fishermen claim to be able to tell from the appearance of the brook trout they catch in our streams whether the fish was planted from a hatchery or came from the wild stock in the stream. I do not believe this is possible as a rule, but it is quite likely that the old trout fisherman can see a difference in the color and markings of the hatchery trout which he catches today as compared with the wild fish which he caught twenty-five years ago.

If we are right in claiming that the quantity of trout which our streams produce is dependent on our hatcheries, then we must also be held responsible in a large measure for the quality; and in this connection the fish culturist should always remember that on the vigor of the parent stock depends, not only the quality of the offspring, but the quantity as well.

DISCUSSION OF MR. SYKES' PAPER.

Mr. Titcomb: I heartily concur with the writer in all that he has said about inbreeding and getting a good quality of fish by introducing new stock, and I may perhaps say in that connection that the commercial fish culturists almost all do that in the East. On the Massachusetts coast where the commercial hatcheries are so plentiful, they very frequently call upon us for the eggs of the wild trout and rear those to mix with their brood stock, and thus obtain new blood. Some of the hatcheries introduce new blood by that method every year. I think that this idea can be carried out beyond the commercial hatcheries and beyond our brood stocks at any of our state hatcheries. I think that the changing around of the stock of trout in our natural ponds will tend to strongly invigorate the trout. In traveling through the trout country of the Laurentian Mountains in Canada I was very much surprised to find lakes teeming with trout where the stock had apparently run down. I could not find any other reason for it except in breeding. The ponds were of large size, full of food, but the fish were small and the eggs of very inferior quality. In fact, at one place where I was trying to collect the spawn of the wild trout in the Laurentian Mountains, we took something like 6,000 fish on the spawning beds, and in a week's time got less than 100,000 eggs from those fish. The eggs were inferior and seemed to be diseased. The fish themselves were apparently all right—good eating, and rather thin, notwithstanding the abundance of food. That idea of introducing new stock I think should be carried out very frequently in connection with our work. I have carried out that idea, so far as possible, in connection with the collection of eggs of the wild trout from different waters. When returning a proper quota of product of these eggs to the waters where we made our collections, instead of returning the product of the eggs that were collected at any particular station, we took the hatch of eggs taken from some other point, and each year changed them around, so that at all of our collecting stations new blood was introduced annually.

Dr. Birge: I would like to ask whether any fish culturists have tried this method Mr. Sykes speaks of of selecting the individual fish to breed from to keep up the stock of breeders.

Mr. Titcomb: I know to a certainty that one of the fish culturists in Mr. Lane's neighborhood selects the larger fry—that is, when he sorts out his fry he takes the larger ones. Sometimes you will find, as you know, fry two inches long in with fry of the same age or about an inch in length.

Another point we might consider is that the commercial fish culturists are rearing trout for the market, and the market demands a small fish. The result is that they are taking most of their eggs from fish a year and a half old, what we call yearlings, and those eggs are very inferior to the eggs of the fish a year older. The United States Commission in obtaining eggs have adopted a rule not to accept any eggs from fish less than two and a half years old, for that reason, but the tendency of distributing these eggs from the younger fish all round the country, selling them to state commissions and private hatcheries, is toward the introduction of an inferior fish.

Mr. Lane: I would state for the benefit of the society that I always manage to select my fish from the eighteen months' old fish, but I select them when they are fingerlings; that is, I will, for instance, select them this fall from the fish hatched this spring, and from those fish I take the stock to replenish my stock with. As Mr. Titcomb says, I have introduced new eggs from other hatcheries, but I never have thought that the inbreeding ever hurt my fish at all. I have not seen any ill effects of it. But I have only been at it seven years, and perhaps it would not occur in that time.

Mr. Titcomb: Introducing eggs from other hatcheries counterbalances the inbreeding.

Mr. Lane: I never thought that they did deteriorate by inbreeding, because of putting in this new blood—that is what I meant to infer, that the introducing of this new stock kept the old stock up to the standard.

Mr. Titcomb: That is just the point he makes, that you should do that.

Mr. Lane: That is what I have done. But I have saved the stock on the very principle that you mentioned, that the market does not require large fish. When I send them to New York for food they do not want over half-pound fish; they will take them as high as three-quarters of a pound, but from one-quarter to one-half a pound is as big as they want; and in that way good, nice fingerlings and two years old are plenty large enough. So we do not keep fish until they are two and a half years old; we cannot keep them to sell many eggs from, and that is the reason that these commercial hatcheries sell them young and have nothing but the eighteen months old fish to take the eggs from.

Mr. Clark: There is one point in this paper in which I do not quite agree with Mr. Sykes, and that is in reference to the color of the eggs of fish that are bred in and in. I had the impression from the paper that the color of the eggs indicated that the fish had been so bred.

Dr. Birge: I did not so understand it.

The President: He thought the markings became less distinct and clear.

Mr. Clark: He spoke of the eggs.

Dr. Birge: I recall nothing of the sort. He mentioned selecting fish of good colors.

FEEDING: ITS EFFECT ON GROWTH AND EGG PRODUCTION.

BY W. T. THOMPSON.

The relation of food to growth and production has ever been a most interesting subject for speculation and experiment; not alone to fish culturists or to the present generation, but to all mankind and throughout all ages this problem, in its broader sense, has appealed to each individual in a peculiarly personal way. The farmer studies his soil, what food will best promote the growth of his crops, and enable him to reap the largest harvest from his fields. The stockman, that he may produce the best quality of beef, mutton or pork in the shortest time, and with the largest margin of profit. It is a subject pregnant with interest to the gardener and the horticulturist. It appeals to the machinist and engine driver, what fuel will produce the most power at the least expense? It is not absent from one single vocation. It is a strongly pertinent query even in the home life, what foods or combination of foods will promote the best growth and development of the children; preserve the health and strength of the adults; prolong the period of productiveness and usefulness in the bread-winners?

In the earliest dawn of history, we read of families, tribes and even nations, migrating from place to place to secure better and more abundant pasturage for their flocks and herds, thereby increasing their own food supply. This was one of the very first questions man was called on to grapple with. It still presents a splendid field for investigation and experiment. At no time has it received a larger share of attention than it does today. Scientists and chemists of the highest order are giving this food problem their closest attention. The question of constituents, proportion, amount, ease of assimilation, etc., is still puzzling the wisest minds.

My own study has not been limited to the circumscribed area included by my topic. It has been my privilege and pleasure to consider it in its broader relations to animal and plant life generally. Each germ, each embryo has its possibilities, whether it ever attains to them or in what measure it falls short depends on the surrounding conditions during the period of growth, whether these be favorable or the reverse. Herein this same question of food supply assumes a position of primary importance. The Percheron and the Clydesdale, with their grand proportions, their majestic bearing and their remarkable strength, trace back to the same ancestry as the shaggy, diminutive Shetland. The food conditions have been different. There is but little resemblance between the luscious Northern Spy or Baldwin from our highly fed and cultivated orchards, and the wild crab or seedling growing by the wayside.

In the present paper I shall consider the food question in its relation to fish life only from the standpoint of quantity. The consideration of its quality, its proper combinations of elements to produce the best results, being left for some later day, perhaps for some later generation. We will assume that experience has, to some extent, taught each fish culturist what food or foods are the most economical and satisfactory under his own peculiar conditions.

The results which I shall endeavor to bring to your attention were not obtained in experimental work under peculiarly favorable conditions, but where the outcome of the regular work of the Nashua Station, under charge of Superintendent Waldo F. Hubbard, and obtained in spite of the usual drawbacks incident to a first season's work at any new station. There was no intention of producing any abnormal growth of egg production, merely to ascertain in a practical way the effect varying quantities of food would have on health and growth. Later the matter of egg production was also included.

The lot of fish in question were brook trout, numbering about 5,000, hatched in the spring of 1900, and were reserved from the fall distribution to be reared for breeders. Prior to this time, they were all treated alike, fed generously on beef liver, which diet was continued throughout the entire period. About the first of October, 1900, they were sub-divided into four lots and placed in winter quarters. At this time they averaged from one and a half to two pounds per 100. Lot No. 1 received practically all they would eat. Lot No. 2 about 80 per cent, while Lot No. 3

were fed 65 per cent, and Lot No. 4 only about 50 per cent of their capacity. Lot No. 4 was in a larger pond where they secured some natural food in addition to their daily rations. From this time until the following August they were fed twice per day, then but once till the commencement of the spawning season (November) when they were fed but three times per week. No markd difference was noted as to health amongst the various lots, although the death rate, which was only nominal, was a trifle higher amongst the smaller fish. In the matter of growth however the difference was most markedly in favor of those receiving the larger rations. A monthly record of the growth of Lot No. 1 was kept for one year, as follows:

Weight per 100 fish:

Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug	Sept.	Oct
2 lbs.	4½	5¾	8¼	11	12¾	16	20	28	34	45	55	60

This included both males and females, the former being naturally somewhat larger. One day during the spawning season ten representative females were selected from each lot and weighed, prior to stripping, to ascertain the comparative growth:

Ten fish from

	Lot No. 1.	Lot No. 2.	Lot No. 3.	Lot No. 4.
Weighed	5½	3½	2¾	2

Spawning was practically over by December 18th, and the few spawners remaining in the various lots were put together for convenience, but these unripe fish are noted with their proper lot in the spawning summary which follows:

SPAWNING SUMMARY TO DEC. 18, 1901, INCLUSIVE.

	Lot No. 1	Lot No. 2	Lot No. 3	Lot No. 4	Total
Females spawned,	111	351	513	735	1710
Barren females,	none	20	27	55	102
Total Fem in spawning sum.	111	371	540	790	1812
Per cent females spawning,	100	95	95	93	94
Per cent females barren,	0	5	5	7	6
Eggs taken,	104,400	199,800	234,900	285,750	824,850
Average No. Eggs per fish,	940	560	458	389	482
Females unripe Dec. 18,	16	51	39	23	129
Total females including above,	127	422	579	813	1941
Total males (lots not kept separate)	.....	......	....	....	3102
Total males and females,	......	......	....	....	5043
Per cent females,	......	......	....	....	38.5
Per cent males,	......	......	....	....	61.5
Average size (inches)	10–12	8½–10½	7–9	6–7½	....
Aver. weight females only (oz)	8.8	5.6	4.4	3.2	....

Now let us assume for the sake of comparison that Lot No. 4 is an average of the twenty-one months' old brook trout reared throughout the country. Certainly fish of this age weighing 3.2 ounces, probably 3.5 ounces with males included, (commercial fish culturists begin to market their fish the following April when they desire a standard weight of 5 ounces or three fish to the pound) with 93 per cent yielding spawn, averaging 389 eggs each, would seem to be up to the standard, and we obtain the following convincing showing as to the value of the extra food supply:

	Per cent extra food	Weight oz.	Excess wt. oz.	Per cent extra weight	No. Eggs	Excess Eggs	Per cent excess Eggs	No. Eggs to the Liq. oz.
No. 4	......	3.2	......	......	389	......	......	460
No. 3	30	4.4	1.2	37.5	458	69	19	450
No. 2	60	5.6	2.4	75	560	171	44	408
No. 1	100	8.8	5.6	175	940	551	141	378

A query naturally arises as to the exact source of this excess egg production. Is it the direct result of the stimulation of the ovaries, by the extra food supply, to such an extent as to increase the number of embryos on the one hand, or on the other, is the lesser nourished fish unable to develop and mature the full number of germs initiated? Courtesy to other contributors prompts me to refrain from trespassing further on the very limited time at the disposal of the society, by following up this branch of my subject further than by the suggestion that it will afford the student a very interesting and profitable field for further thought during some leisure hour.

Before closing I wish to state very positively that I do not advocate full feeding for adults. If range, temperature, and conditions generally are favorable, nothing but the best of results will follow such a course with fish under two years of age. The remarkable growth during this period coupled with the extensive demands made on the system in maturing the product of the ovaries, can only be provided for by a most generous system of feeding.

For the benefit of those who may wish to study this matter more closely, I attach herewith a detailed record of our spawning operations for publication in the transactions of the Society.

DETAILED RECORD OF SPAWNING, NASHUA STATION.

	LOT No. 1		LOT No. 2		LOT No. 3		LOT No. 4			
	No. of Fish spawned	No. of Eggs Taken	No. of Fish	No. of Eggs	No. of Fish	No. of Eggs	No. of Fish	No. of Eggs	Total Fish	Total Eggs
Nov. 8..	....	....	7	4950	35	17100	104	48600	146	70650
Nov. 12.	....	....	13	8550	9	4950	81	34650	103	48150
Nov. 14.	4	4500	15	9000	39	22050	68	29700	126	65250
Nov. 16	6	4950	18	10800	32	15750	78	31950	134	63450
Nov. 18.	5	3600	16	9000	44	18450	76	31050	141	62100
Nov. 21.	9	8100	35	20700	41	18000	32	14400	117	61200
Nov. 23	7	5850	29	17100	66	29700	52	17100	154	69750
Nov. 25.	10	9000	36	19350	48	18900	46	15700	140	62950
Nov. 27.	11	8100	28	15300	22	10800	23	6750	84	40950
Nov. 29.	4	4950	17	10800	21	17100	27	10350	69	43200
Dec. 2..	16	18450	43	28350	60	27900	30	11250	149	85950
Dec. 5..	16	13500	35	18000	50	17100	44	13950	145	62550
Dec. 7..	1	900	16	5400	9	3150	20	4950	46	14400
Dec. 9..	4	4950	14	7650	8	3150	10	3650	36	19400
Dec. 11.	5	4950	10	5400	10	2700	17	4500	42	17550
Dec. 13.	5	4500	6	3600	11	5400	8	2700	30	16200
Dec. 16.	6	6750	5	2700	5	1350	13	3150	29	13950
Dec. 18.	2	1350	8	3150	3	1350	6	1350	19	7200
Total..	111	104,400	351	199,800	513	234,900	735	285,750	1,710	824,850

FISH CULTURE ON THE FARM.

BY J. J. STRANAHAN.

It is safe to presume that the members of the society will think that this subject has been selected because the writer is too lazy to prepare a paper along more scientific lines and if this be the case, the presumption will be well founded, although much of interest and value may be said on fish culture on the farm, a subject that has been too long neglected by this association, the United States and state fish commissions and by fishculturists generally.

With our public waters rapidly becoming depleted through excessive fishing, in spite of the good work being done by the hatcheries, where are we to look for the fish to fill the very rapidly growing demand, if not through water farming? Of course the output of ocean, lake and stream may be held in statu quo or possibly increased to some extent by reasonable restrictive laws and by the work of fishculturists, but with the rapid increase of our population and the further growth of consumption through improved transportation facilities, the limit has doubtless already been reached and any permanent increase of per capita supply must come through covering what is now unproductive land with water, thus adding to the output of fish beyond what natural waters would make it, and making many fins grow where none at all grew before.

There are vast areas in all of the states, probably equal in the aggregate to that of the Great Lakes, which now produce virtually nothing and much of which might be made to furnish abundance of fish, with comparatively little expense.

Not only would the conversion of this waste land into water areas increase and equalize the rainfall to some extent, but it would measurably decrease the liability to disastrous floods and equalize the flow of streams. But this is only incidental to my text and not really germane to the subject.

Fishculture on the farm is, nine times out of ten, a failure, and generally so because of three main causes, none of which, owing to lack of space, can be fully treated here. We will take first in order the failure to properly construct the embankments which are to retain the water. Very briefly stated, the sods, brush, grass and other rubbish should be cleaned away down to the solid earth over the whole extent that is to be covered by the embankment. Then a trench say two feet wide and as deep should be plowed lengthwise throughout the whole extent that is to be covered by the embankment. The earth of the embankment settles into this preventing leaks which are almost sure to follow along the union of the old and well packed earth and the new soil, if this is not done. No brush, sods, stumps or other rubbish should be permitted to enter the embankment. Use nothing but clear earth and if the soil be gravely to the extent that it is likely to permit the water to filter through the inner face of the embankment, that is, the one next to the water, should be faced with a foot of clay or other impervious soil. The plow and scraper will be found the most economical, unless the lay of the ground is such as to prevent, when wheel barrows will be necessary, and the team should be kept on the embankment while going and coming as much as possible, so that the earth will be packed as much as possible and prevent sloughing when the water is let on. If the embankment is made of proper width at the bottom and the correct slant given to the sides—observe the slant given by nature in your vicinity—you will have an embankment that will last for generations and give you no trouble.

All ponds should be provided with a sluice or outflow through which the ordinary discharge flows and through which also you may discharge the water when you wish to draw down your pond, a matter strictly indispensable to successful pond culture. The sluice may be most economically made of two-inch plank a foot wide and should be long enough to go clear through the embankment, the outflow, or perpendicular part being securely spiked to the horizontal part which runs through the embankment and is situated low enough to draw the water entirely out of the pond. The face of the upright, that is, the side opening towards the pond, is, of course, left open, the box being closed on three sides, the open side being left for the discharge of the water. Two grooves should be provided by nailing three strips onto each side plank of the upright. Into the back groove boards an inch thick and three or four wide are slipped, these retaining the water at its proper height, the surplus being discharged over the top board, and these being removed one at a time when you wish to lower or empty your pond. Into the front groove the frame of your screen is slipped from above. This should be covered with galvanized wire cloth with about one-half inch mesh. This should be used only when the pond is being emptied or lowered, for the few fry which will escape ordinarily amounts to nothing, in fact, you are sure to have too many after your first hatch in any event.

The second cause of failure is the selection of too high-toned fish and the introduction of too many species. Not over two or three species should be put into any pond of a few acres or less, and the more desirable ones from your vicinity are likely to prove the most successful. To introduce brook trout, unless you have a very large spring of cold water, will lead to failure, and no matter how much water you have and how cold it is, you would better leave the trout alone unless you know something of their culture or wish to study their habits and make a pastime of their cultivation. The same is true of the black bass, unless you have a pond of several acres or wish to sacrifice a good supply of fish for your table for the sport of capturing a few bass with rod and line, which, after all, can be best accomplished in some nearby public water, leaving your pond for the cultivation of those fish which will provide you the maximum of good food with the minimum of trouble and expense. If black bass is decided on, in nine cases out of ten, north or south—the small-mouth is not indigenous to the south south of north Georgia—the large-mouth species should be selected, the only exception being where the pond is supplied with an abundant supply of cold water and where the bottom of the pond is gravely or rocky throughout a considerable portion of its area. If the bottom of the pond is soft, suitable for the growth of aquatic vegetation, then the large-mouth should be introduced by all means, if bass are to be selected at all.

The best all round fish for small ponds, north or south, is, in the opinion of the writer, what is known as the marble or mottled catfish in the north and the speckled cat in the south, *Ameiurus nebulosis,* from nebulous, clouded, which is easily identified by its square tail, which is not forked in the slightest degree, and by its mottled skin north, while in the south it is covered with black specks on a light slate background. This is an excellent fish, making a rapid growth for the first two years in particular, cleanly in its feeding habits, being in no sense a scavenger, almost omnivorous in its selection of food and growing to weight two or three pounds, often attaining to one pound when a year old, when the range is ample and the food abundant. This fish does not interfere with other species in the pond, either through destroying the young or the eggs of the other. In fact, any nest-builder, such as the rock bass, black bass, bream or sunfish will defend its nest and eggs against all comers, even if it be a mud turtle of many times the weight of the fish. Taking it all in all, the writer believes that this fish will produce a greater weight of good food from a given area of water than any other that swims.

Taking the country as a whole, the writer believes that what is known as the blue-gill sunfish north and the bream south is the next best fish for small ponds, although he would possibly modify this statement to let in the rock bass where the water supply is especially good and the considerable gravel entering into the soil in the bottom of the pond, and it is possible that this fish may prove a desirable pond fish in the south, it having been acclimatized in Texas, where it is doing well in public waters. The blue-gill, or bream, *Lepomis pallidus,* is of excellent quality, dresses to waste but little, is a rapid grower and is esteemed by many as next only to the speckled brook trout as a pan fish, while my good friend and enthusiastic angler, Mr. C. T. Hasbrook, of Cleveland, O., claims that when taken on a fly with light tackle, he offers sport as a game fish second only to the speckled beauty of the brooks. Probably Mr. Hasbrook is the best posted gentleman in the world today on this fish, and he considers it one of the most desirable for table as well as at the end of a line. While it sometimes attains a weight of three or four pounds in the south, a pound will be found to be about the maximum for this fish in ordinary pond culture. Like the speckled cat, it is not predaceous to any appreciable extent, defending its own nest vigorously and leaving others to do the same unmolested by him. It is omnivorous, eating almost anything that you give it, provided the food is clean and that decomposition has not set in, and finding much of its own food in the pond in the shape of small crustacea, larvae of insects, worms, etc. If rock bass are to be had in your vicinity and not the blue-gill or bream, it would probably be best to introduce them.

In stocking your pond, half a dozen pairs of each species are a great plenty and even these will overstock your pond the first year if two or three pairs of each bring off broods. It is by far the better plan to collect adult fishes from near by waters for stocking your pond. These will bring forth young two years earlier than the fry furnished by the United States or state hatcheries, besides, being acclimatized, they are likely to do better.

If black bass are to be introduced it is well to also put in brook minnows, such as chubs, shiners, suckers, etc., but care should be exercised that undesirable forms, such as pickerel, etc., do not slip in with them and lead to serious regrets later for it is easier to keep out undesirable fishes than to eradicate them when once established.

The third, and one of the most fruitful causes of failure in fish-culture on the farm, is over production. The first year's hatch of the fishes above recommended with the numbers of adults suggested, will overstock any ordinary pond of a few acres. Just as soon as the fish are large enough, probably in the fall of the year when they are hatched, the owner should begin catching them for the table. They will not be very large but sufficiently so to make a nice little pan fish and their quality will be fine. The more you can get out and consume the better. At the end of the spawning season of the second year your pond should be drawn off and the surplus fish turned into the near by stream or lake, thus paying back to nature the debt you owe her.

It is a hard matter to advise just how many fish of each species should be returned to the pond, the natural inclination being to make it too many. One hundred of your yearling black bass and twice the number of bream and catfish is plenty for each acre of water, and too many, unless you are pretty persistent in catching them out, and not over that number of fry should be retained to come on for the coming year's supply.

To recapitulate: Make your embankment good and safe; don't try to breed too high-toned fish; look to it that your pond does not become overstocked and, other things being equal, you will succeed.

DISCUSSION OF MR. STRANAHAN'S PAPER.

Mr. Titcomb: I think Mr. Stranahan has brought out one very important point there. In the first place, this question of fish culture on the farm is very important, and it is not taken up enough in this country, and a great deal might be made of it. I can see in my work in Washington that this form of fish culture is growing very rapidly, especially in the west and southwest.

But he brought out in the paper one other point which every fish commissioner and culturist must appreciate, namely, the fact that people who know nothing about what they want will apply for some variety or species of fish that does not inhabit their waters—they want something new. Somebody up in Connecticut will send down for Calico bass, for instance, when they have black bass or trout. They may have all the fishes that are desirable in their waters, but they want something entirely new. It is a great mistake to try to get too many varieties of fish in a pond. We had an application in New England in the past week where they had black bass, pickerel, sunfish and yellow perch, and they wanted us to introduce the rock bass. In my opinion they had as many varieties as the pond could well sustain, and it is a great mistake to try to get in too many varieties.

Mr. Lane: Mr. Wood in his paper in last year's report said something about the different kinds of parent trout that they received eggs from, and I inferred that he preferred the wild trout. I have found in one instance that I shipped some trout eggs to Pennsylvania, and 50 per cent or more of them died, and the man wrote me that it was pretty near a total failure. But out of the same lot and on the same day there were some shipped into the state of Maine, and those I have been informed, hatched out 94 per cent. They were the very same eggs exactly. I wish I knew the cause of the trouble, but I think I have learned something in the discussions I have heard here on that point. Now, I would like to know what difference there is between the wild trout egg and a good, domesticated trout egg, for hatching purposes. I do not know, but I should like to.

Mr. Titcomb: That subject I have studied. I have taken every year for the last six or eight years, eggs of wild trout from different ponds and streams and have been handling at the same time the eggs of domesticated trout from commercial hatcheries. The eggs from the wild trout in every instance have proven to be the most hardy, and have produced the most hardy fish; but I am not prepared to say that your fish are not just as good for your waters. The longer I investigated this question the more I was inclined to believe that possibly these domesticated fish had become accustomed to a certain quality of water. I think Dr. Bean has touched on this point in connection with the changes brought about by domestication. My waters were all extremely cold in the winter, and these eggs of the wild trout naturally were accustomed to this extremely cold water. I think possibly that the eggs of the domesticated trout introduced into our waters suffered very much as do the rainbow trout introduced into our extremely cold waters. I do not think it is all weakness in the fish, because in many instances these domesticated eggs have been reported from other stations as yielding a very large per cent of fry, and in some cases have yielded well in fingerlings, also.

Mr. Lane: Does not the condition of the fish depend a great deal on whether they are allowed to breed in and run out, or whether new stock is introduced?

Mr. Titcomb: Oh, yes, I think you want to introduce new blood in your commercial hatcheries every year, and you cannot do that better than by introducing the product of the wild eggs.

Mr. Lane: Whether the domesticated parent trout were properly cared for is what I am trying to get at. I believe Dr. Bean said that inbreeding would injure the quality of the eggs.

Mr. Titcomb: I think if you take a commercial hatchery and rear trout year after year, and then take the product of your own brood stock and rear them up, you will gradually weaken your stock; but in these comparisons I was making between wild and domesticated eggs, I would say that I received domesticated eggs from four different commercial hatcheries and compared them with the wild eggs, put them in the troughs right beside the wild eggs, and gave them the same treatment. No disease existed either with the wild eggs or domesticated eggs.

SOME REMARKS ON THE RAINBOW TROUT, THE TIME FOR PLANTING, ETC.

BY GEORGE A. SEAGLE.

The rainbow trout are unlike the brook trout in several respects; they grow larger and inhabit larger and warmer streams, and vary much more in form and color. Their rate of growth is hardly equal to that of the brook trout under similar conditions, but the brooks reach maturity earlier. In domestication the rainbows can hardly be considered cannibalistic in their habits, although occasionally one is observed in the act of swallowing his smaller and weaker brother. Their natural food consists chiefly of worms, larvae, crustacea and the like, but in their wild state necessity compels them to seek such food as may be found. If they do not find their preference they must accept something else, and in that way they get a taste of fish and the cannibalistic habit is established.

Much has been said and written about the time, or season, for planting trout in streams, and it seems to me that the success of the work must depend largely upon this point. In my opinion there is but one favorable season, and that is spring.

With the warming up of the waters the natural food makes its appearance, and fish planted in the streams at that time need not go hungry. They can select such food as their stomachs may dictate—worms, larvae, or young minnows. Contrast these conditions with those existing in the fall and winter months, and you have all the argument necessary in favor of spring planting. In the fall and winter the streams are practically barren of food, nothing left in them except minnows, and they have become too large to serve as food for the young trout. Therefore I would plant trout in the spring and let them keep pace with their food, and when cold weather comes on, and food becomes scarce, they will be more able to cope with the situation before them.

It has been argued that small fry are too delicate to take care of themselves in open waters, but if that be true how can we expect them to multiply in the streams? If fry from two to four months old, and averaging from one to two inches in length, cannot survive what may we expect of the eggs, and the alevins, which have been deposited in the streams by the parent fish?

Again, if the young trout were planted in the spring season the output of the hatcheries could be more than doubled, and the assignments to the streams could therefore be made much larger. The saving in food would more than pay for the increased production, and the cost of the distribution would be lessened.

DISCUSSION OF MR. SEAGLE'S PAPER.

Mr. Seagle: Before reading my paper I desire to say in regard to it that I have expressed my views as to the matter in hand as briefly as possible. I simply want to introduce it here and have it discussed by the members of this association, and see how many, if any, agree with me.

Mr. Titcomb: Do I infer from your paper that you would plant all trout in the spring—brook trout as well as rainbow?

Mr. Seagle: Yes, sir, I would plant them as early as possible after the spring season opens, and the waters begin to warm up.

Q. At what age after feeding—you feed for a while?

A. Yes, sir; our fish hatch from December 1st to March 1st, and I would plant them in April and May. They are then two to two and a half inches in length and in every respect, I think, able to take care of themselves.

Mr. Peabody: How large do rainbow trout grow down there?

A. Six and a half pounds is as large as we have grown any in our ponds; although they grow much larger in some sections of the country, especially in the west.

The President: You are in the southwestern part of Virginia?

Mr. Seagle: Yes.

Q. And your spring comes on a little earlier there than it does up here?

A. Yes, sir. April would be a favorable month for us, that is, in most years. We usually have nice weather, especially after the middle of April.

Mr. Peabody: Do you have the brook trout in the same streams with the rainbow trout?

A. Not naturally so. We have streams that used to be stocked with brook trout, but they are pretty well extinct now.

Q. Do they thrive together, with you?

A. I think they would, except that brook trout, of course, have more of the wild nature.

Dr. Birge: Has it been our experience, General Bryant, in Wisconsin, that the brook trout and rainbow trout would thrive in the same stream?

The President: They have been planted in the same stream, but I think the rainbow trout drift down to the larger streams and the brook trout work up toward the springs. That has been our experience. Our large rainbows are caught in the larger streams like the Willow River.

Mr. Seagle: That has been our experience also. The brook trout seek the upper waters or the colder part of the stream—clear waters. They do not thrive so well in muddy streams. Of course I do not mean to say that muddy streams are suitable for any kind of trout.

Mr. Clark: Speaking of the brook and rainbow trout inhabiting the same stream; there probably is not a better example of it than the Au Sable River in Michigan. Brook trout and rainbow trout are both thoroughly established in that stream. Of course, as you are all well aware, it was formerly the leading grayling stream in that respect in the United States, but now they are nearly all gone. On the Au Sable are found the rainbow trout,and more especially the larger ones, in below the brook trout; but where brook trout fishing is good rainbows will be taken, but they are of the smaller size. The fry of the rainbow trout and brook trout (I am speaking of fry until say July and sometimes later) are found together—I think as late as October, when we were catching parent fish there. We have taken probably as many rainbow trout fry as we did brook trout fry, with the net; so proving that they were right together. It has therefore occurred to me that the larger rainbow trout go down below simply because they are larger. I have seen these large rainbow trout in the spring of the year when they were spawning, about the middle of March, way up the stream as far as they could go.

In speaking of the planting of fish in the spring: I do not agree with the reader entirely. I think it depends on the age and size of your fish. If you are going to plant fry, plant them before they have been fed at all—in fact plant them just before the sac is gone. If you are going to plant the others, do so after they are partially grown.

Mr. Titcomb: I do not think it is possible today to have in this society the discussions on this question that prevailed a number of years ago and which caused the subject to be tabooed, you might say. I think the fry men and fingerling men are coming together to a certain extent. Now, I have watched for the last twelve years the results from both fry and fingerlings, and I am inclined to agree with Mr. Seagle (I would not say in the spring, just as he does) but, as Mr. Clark says, it depends on the size of the fish; and what fish would be suitable to plant in April in Mr. Seagle's country could not be planted in Vermont, for instance, until July; and we there have begun the planting of fry after they have been fed two months, to thin them out and give us more room; and we then kept up the planting until they were three or four inches long. But the results with the brook trout with us seemed to be better with fingerlings; that is, with these fish that are of the age Mr. Seagle speaks about, than with the fry just after the sac is absorbed or just before. Then you take another variety, the land-locked salmon. They were planted as fry in Vermont a number of times without any results at all; then we raised them to fingerlings and planted them in September and October in lakes, and got remarkable results. So that while it might be profitable to plant brook trout when they are quite young, my experience has been that in introducing fish into lakes, except into streams that are full of minnows, the fingerlings are far the best and produce the best results. On the other hand, in our Vermont work, we have planted the lake trout as fry just before the sac is absorbed and before they have been fed, with quite as good results as from planting them as fingerlings; and we have planted them in a lake where there were no lake trout, with very remarkable results. I think I spoke about it in the last meeting, where we had introduced them in one lake, and in three years' time they were having splendid fishing for lake trout. So that we cannot have any hidebound rule about this thing. I like to feed the fish awhile, and I do not think we ought to plant them until they have been fed two months, if we plant them after they have been fed at all.

The President: You do not want to keep them until their spirit of self reliance is all gone.

Mr. Titcomb: I do not think there is much harm keeping them through the fall, but just as good results are obtained from planting them earlier.

The President: Some years ago there was a large surplus of male fish at the Madison hatchery, and we liberated them in a stream which was formerly a good trout stream—quite a number of hundred of them. They were fish reared in ponds and are pretty good size, and we got returns from them after awhile, people caught them, some months after they were deposited in the river, and they were found to be pretty nearly starvd. They did not know how to get a living.

Mr. Titcomb: Those were adult fish?

The President: Yes. Have you ever had any such experience?

A. No, sir.

The President: Those were the reports we got—there were some of them caught, but they were mere shadows, unnourished, starved.

Mr. Titcomb: Was there an abundance of fish in the stream where they were placed?

The President: It had been a good trout stream in its day—naturally—but it had been fished out.

Mr. Titcomb: I should infer that the food was gone, too.

The President: That might seem so, or that they did not adapt themselves to the new environment.

Dr. Tarleton H. Bean: Is it not probable that the reason no rule can be very well established for the distribution of all these trout and the young salmon, is that the differences between them are rather complicated? Our lake trout and land-locked salmon have different spawning habits from the brook trout and the rainbow trout. The young brook trout feed largely at the surface, whereas the rainbow trout is a bottom feeder, and there are so many different lines of variation arising from the nature of the fish and its habits, that you cannot fix a hard and fast rule, but must be governed by experience and observation of the actual results of planting. It would be of great advantage in point of economy if a man could get rid of the fish early and get the same results as he would obtain if he held them longer before disposing of them; but you must not lose sight of the fact that we are dealing with a pretty big range of territory and habit when we talk of rainbow trout, brook trout, lake trout and land-locked salmon. They are four just as clean-cut and distinct animals as you can very well associate in aquatic life, and I do not believe we will ever arrive at a rule, except the rule of the results which experience demonstrates.

Mr. Clark: Why do you call a rainbow trout a bottom feeder? I never have been able to see a great deal of difference between rainbow and brook trout in that respect. I have seen them both take food from the bottom of the water; but the rainbow trout takes a fly quicker than the brook trout.

Dr. Bean: Because in their wild state, in the region from which they were first obtained for artificial introduction, they were observed to be bottom feeders; that is their original instinct, but fish under domestication are not wild fish and may change their nature. That should be carefully considered.

Mr. Clark: How about the wild state of the rainbow trout?

Dr. Bean: We have no wild native rainbow trout.

Mr. Clark: The ones planted wild.

Dr. Bean: We have none. We have had generation after generation of domesticated fish, fish brought up and taught new tricks.

Mr. Clark: How about the rainbow trout eggs brought here from the Pacific Coast, taken from wild fish and planted in our streams here?

Dr. Bean: How long will it take a fish to learn a new habit?

Mr. Clark: I do not see how they can get new habits when they are hatched from wild eggs and brought from wild streams.

Dr. Bean: Whitefish from Canandaigua Lake learned to eat killifish as quick as brook trout. Domestication works so many and such sudden changes in fish life that you cannot estimate the effects, except by experience.

Mr. Titcomb: Do not the rainbow trout on the Pacific Coast in their natural habitat take the fly?

Dr. Bean: Yes, but it is known on the Pacific coast as a bottom feeder more than anything else. They may be seen boring right on the bottom, as cod do sometimes, standing on their heads and boring down. But it does not seem to do so here.

To show how domestication may change the habits of a fish, you all know about the experiment in France in the rearing of the big Pacific salmon in fresh water. Two years ago I saw in the aquarium of Paris at the Trocadero, fish hatched from the eighth generation of eggs, the parents of which had been retained in fresh water, and the fish never had access to anything but fresh water. Now, there was a sudden change of habitat and habit, and you would think it inexplicable almost, but they are all good healthy fish, although it is the eighth generation from eggs brought from the Pacific coast. It shows the wonderful influence of domestication in altering habits.

Mr. Clark: I did not question that matter at all. I am well aware that domestication changes fish naturally, but I could not see how that eggs taken from wild fish on the Pacific Coast, brought here, merely hatched on trays, and the fry be planted in a wild stream here, could be said to be in the line of domestication. That was the only point.

The President: There might be a change of environment or external conditions, such as feeding, etc.

Mr. George F. Lane, Silver Lake, Mass.: There are four weeks of their life when you do not feed them, and that in my experience domesticates them considerably.

Mr. H. D. Dean, of Neosho, Mo.: Why do not brook trout survive and thrive with us? They do not, although the rainbow trout do. I cannot take the eggs from the fish raised at the station and get any large percentage of returns from planting them in our streams.

Mr. Clark: I do not know why Mr. Dean would say that they do not thrive there, when I think at his station before he was there, they made quite a spread in the growth of brook trout in the first year; in fact they had fish nine inches long, when we had some at the same age which were only six inches long.

Mr. Dean: That is so at the station, but you cannot take eggs from those fish and raise any percentage. What I meant was fish that had been put out. We put fish in our springs and they totally disappear.

The President: What is the quality of the water?

Mr. Dean: There is some lime in it, but it is not extraordinarily hard, although rather hard.

Mr. Titcomb: The brook trout won't live in the same waters that you find plenty of rainbow trout in.

Mr. Dean: Yes, that is the point.

Mr. Titcomb: And those waters do not reach a high temperature at any time?

Mr. Dean: The water temperature of almost all springs in Missouri runs from 56 to 58 degrees Fahrenheit—one or two run a little higher.

Mr. Peabody: It is not a question of food?

Mr. Dean: No.

Mr. Titcomb: You may ask why can't we raise rainbow trout in New England. That is the fact with us. Where the temperature of the water gets very low in the winter it seems to debilitate the adult fish, and occasionally they will die just at the season of the year when the ice is forming—it must be colder then than after the ice has covered the spring. The water is full of little sparkling crystals of ice; and while we are able to carry a stock of brood fish we get a very small percentage of eggs, and that is the case where we have obtained eggs from different sources, so that we do not have weak fish from inbreeding; and these rainbows have been introduced in New England and in New York state, and in most cases have disappeared after a short time. I have in mind one stream where rainbow trout were introduced by accident. A gentleman had a private pond and reared some rainbow trout and they got into this stream which was a natural trout stream, but the lower end of it warmed up too much in the summer for speckled trout. These rainbows held their own in that stream for a number of years, but all the best fishing was at the lower end in warm water, but they did breed there naturally for a time—in fact at one time there were three rainbow trout to one speckled trout—and yet today you perhaps catch in that stream in the course of a season a dozen rainbow trout, but the speckled trout still holds its own. There are lots of places in Vermont where we have introduced rainbow trout, and they have entirely disappeared—just the reverse of Mr. Dean's experience in Missouri.

The President: Do you attribute it to the coldness of the water as the winter comes on?

Mr. Titcomb: I cannot think of anything except the exceedingly low temperatures, and perhaps the conditions in the spring during the spawning season are unfavorable.

Mr. Peabody: We have had the same experience in Wisconsin.

Mr. Dean: The rainbow trout attains an enormous growth in Colorado in the deep lakes.

Mr. Titcomb: With a deep water lake they can get any temperature they want. They do not get anything below 40 degrees in those deep lakes in Colorado, even in the winter. We get down 30 to 40 feet in our Vermont lakes in winter.

Dr. Birge: In Lake Mendota in 80 feet of water in the winter you get a temperature of 1 1-2 degrees Centigrade—say between 34 and 35 Fahrenheit.

Mr. Titcomb: A good deal of the water in these Vermont lakes comes from springs in the lakes. The lakes form from two to two and a half feet of ice on the surface. The temperature in the summer gets up to 80 degrees, but they have the same cool temperature on the bottom.

A FEW POINTS ON THE BLACK BASS—FOR DISCUSSION.

BY J. B. LAMKIN.

In the spring of 1900 the bass at Cold Springs, Ga., Station, commenced spawning on April 13th, in 1901 they were two weeks earlier, beginning on March 31st, while this year, 1902, they commenced March 10th, three weeks earlier than last year and five weeks sooner than the year before. One would naturally suggest that the temperature regulated this difference, but the average March water temperatures for the three years are as follows: 1900, 61.25; 1901, 62.7; 1902, 58.5. Not much attention was paid to the two weeks difference last season, especially as it was noticed that the March water temperature was slightly warmer than the previous year, but this season, with five weeks difference in spawning and with a colder March water temperature of nearly three degrees over that of 1900 it naturally attracts the attention of those interested in Fish Culture.

Another peculiarity in regard to the spawning, is that we have fewer nests per capita each year. In 1900 we had more than twice as many nests as fish in the ponds, and the spawning period extended over several months, running into August. Last year, 1901, although it was impossible to keep a complete record of all nests, as the fish were transferred to larger ponds, it was conceded by all the station force that much less nesting resulted, and that the spawning period covered a shorter time, the fish not spawning any after the middle of July. This year the scarcity of nests has been very noticeable, and the principal spawning was done in a batch, very little having occurred since April. In 1900 we only had twenty-eight breeding fish, in two ponds. In 1901, eighty-seven breeding fish in three ponds. In 1902, 212 breeding fish in five ponds, the majority of them being two and three year olds. In 1900 and 1901 the breeding fish consisted entirely of wild bass, collected from neighboring ponds and streams, a portion having been brought up from Florida. This year two and three year olds, which were raised at the station were added to the brood stock.

These are facts recorded without any comment, and presented to the society for the express purpose of bringing about discussion, in order that some light may be thrown on the subject. Perhaps the same thing occurs at other stations, but if it keeps up at the same ratio, our bass will spawn in mid-winter next season.

DISCUSSION OF MR. LAMKIN'S PAPER.

Mr. Titcomb: I suggest that it be noted on that paper that it relates to the large-mouth bass entirely.

Dr. Birge: I suppose "having twice as many nests" means that the bass spawn twice?

Mr. Stranahan: Yes, sir, and some of them seven times. We had one male that we called Brigham Young, because he was like Brigham in fathering several different nests, and he fathered two broods at the same time, one just hatched and the other swimming up and taking food, some ten days older than the first mentioned.

Mr. Clark: Does that mean twice as many nests as there were males?

Mr. Stranahan: No; it means twice as many as all of them, males and females. Mr. Lamkin was conservative in just saying twice.

Prof. Reighard: It would seem to me that the average monthly temperature could have nothing to do with the time when the fish spawn. It is a few warm days that bring on the spawning, and if you get a few warm days early in March the fish are apt to soften up and spawn, and if that does not happen the next year until April they will not spawn until April. I do not think the average monthly temperature would afford any explanation of the phenomenon.

Mr. Clark: The same is true of our whitefish and lake trout. Temperature is what controls the ripening or spawning of fish, but it is not average temperature. Of course if the water keeps very warm in the fall and the fish do not commence to run, afterward when it cools down a little they come on and immediately begin to spawn, instead of waiting as is usually done. The cold water fish need cold weather to ripen them, and the warm water fish require warm weather.

Prof. Reighard: The males in all cases among these fishes build a nest and the females come in and spawn. With the sunfish and dogfish these females go from one nest to another, so that it is possible for, say, half a dozen females to furnish spawn for a dozen or more nests. Then if cold weather comes on that batch of fish may be hatched, and these same males may make other nests—building again—then a new batch of females comes in and fills, say, another dozen nests. So you may have more nests built than you have male fish, even twice as many, but a single nest does not represent the product of a single female.

Dr. Birge: That is to say, the eggs are not all ripe at once?

Prof. Reighard: That may be.

Dr. Birge: Are not deposited?

Prof. Reighard: Yes, sir—deposited within a day, perhaps, the fish going from one nest to another, scattering these eggs over the nests built by a number of males. I do not know whether that is true of bass, but it is true of sunfish and dogfish. You may in that way get more nests than fish.

Mr. Titcomb: I should like to inquire in connection with that whether this series of nests taken care of by a small number of males necessitated one male having the care of more than one nest at a time. As I understand it, the male takes care of the nest and the eggs, fans them. Now, in the case of Brigham Young, how can he manage so many nests?

Mr. Stranahan: That condition extended over the season of nearly four months. He had only one nest at a time, and perhaps I might state that in the sixth nest that he fathered the eggs were aborted and all died, and we were rather of the opinion that he followed so soon after the brood that he had just left that he had overdone himself. (Laughter).

Mr. Lydell: Prof. Reighard's remarks are correct. The female does not necessarily get rid of all her eggs at one and the same time. The male fish takes her on the nest and when he is through with her she must leave. If she is not finished she must wait for the next fellow. She may have to visit three or four nests before she gets through. That is not true of the finny tribe alone. (Laughter). On several occasions that I know of I have had the bass spawn the second time. The most I ever had was at Cascade Springs. We had nineteen bass. (That was the experimental stage of the work). Those nineteen bass every one made a nest. There were something like thirty or thirty-five females and we collected the fry from those nests and shipped them, and I packed up my traps and went back to Detroit supposing the season was over with. I had been there nearly a week when I got word from the man at the station to return, that the bass were spawning, and we had nineteen nests just as nice as the others were, nearly as many fish, and nearly two weeks apart. This season I have had bass that have had two broods, and we have one particular bass that has fathered two broods of fish every season in the same place in the same corner of the pond.

The President: Our experience regarding the time of spawning on one occasion surprised us. We were on one of the little lakes at the head waters of the Flambeau, forty-five miles from Lake Superior. The season was unusually cold, and we were there on the 9th of July fishing in those lakes, and our superintendent went to one of the lakes that was notably a bass lake; the small-mouth bass were abundant, and he caught quite a number, but was astonished to find that most of those he caught had not spawned, although they were pregnant with spawn. He seemed to think that unusual for that season of the year; but our season had been very cold and backward there, and that we considered the cause of such late spawning. Do you find it so, Mr. Lydell?

Mr. Lydell: We had some bass spawn this year very late. Prof. Reighard wanted to study the bass when they were spawning, and he had given it up, but after he had returned to Ann Arbor seven or eight more beds were made, and we got quite a few fry from them. I think if I drew my pond down today I would find females that had not spawned. The female requires the attention of the male before spawning, of course.

I have had as many failures in the black bass business as any one. One year at Mill Creek station I had 100 beds with eggs on them, and I did not produce 50,000 fry.

The President: We have had failures in our work. The biggest failure we had was when we made a pen in a shallow lake, where a sort of bed ran up very shallow; we fenced in a lot of bass there by a good fence, and then used your screens. But it went against us some way, and we made a distinct failure.

Mr. Clark: Is it not a fact that the experience of fish culturists has been gained largely through failures? The success of fish culture in the United States at the present time is due to our failures. If we had not had discouragements in the early life of the different classes of fish that we have been working on, I do not think fish culture would be today where it is. I have had failure upon failure all through my life, and still in the main people call me a successful fish culturist.

The President: We have grown wise through a process of elimination.

Mr. Lydell: Our Mill Creek station two years ago was so near a complete failure that the fish commission told me that if they did not have their money in there they would not stay there another minute, but I told them "You had better hang on;" there are lots of things to work out. We have got to keep on studying—don't give it up. I had there that season one hundred and some odd beds; we would have the fish all hatched on the bed and then a thunder storm would come up in the night and the fish would all be dead the next morning, and I would lay it to the thunder storm! The less a man commits himself on the bass question the less he will have to take back in five or six years from now, (laughter) because the conditions in different localities have a great deal to do with the matter.

Mr. Peabody: Which are the easiest for culture, the large-mouth or the small-mouth bass?

Mr. Lydell: In my experience I have not found any very great difference. I think you have got to be a great deal more careful in sorting your small-mouth bass than you have your large-mouth bass. On one occasion we just dumped the large-mouth bass promiscuously into the ponds, and only got five beds. Therefore, I concluded that we had five females in the lot; but they do not seem to trouble one another like the small-mouth bass. We had one year a lot of small-mouth about twelve inches long, and they were all males. They seemed to band together like a lot of outlaws. They would go around the large pond, come to a pair of bass spawning, and all dive into that nest, and I have seen ten or fifteen of them just standing on their heads and rooting the whole thing up; and I drew the pond down in the spawning season and took all those fish out and threw them on the bank, fifty or sixty of them, and after that I got a few nice beds of bass that same season.

Mr. Dean: In relation to the time of the spawning of the bass, I would like to know if anyone has thought that possibly the age of the bass might make a difference in the time of spawning. I did not know but Mr. Lankin might find that one reason. I know the young rock bass spawn later than the older ones.

Mr. Lamkin: I don't know.

DISCOURAGEMENTS IN BASS CULTURE.

BY H. D. DEAN.

This is a wide subject, too wide for the limited time at my disposal, but I will endeavor to present a few facts which have occurred during my five years experience at a bass station.

One of the greatest trials in fish culture, especially bass culture, is the fact that it takes a year to try an experiment, consequently experience is acquired slowly and, while we are trying our theories, the years slip by.

One year we may have a good crop of bass and the next season, under the same conditions, so far as we know, we have almost a failure.

At the Neosho Station we have tried many schemes that seemed feasible under the conditions existing at that station. At first the breeders were placed in the ponds in March; the ponds were drawn in July and the young fish transferred to hatching troughs; the fish were taught to take artificial food and thus carried until distribution which usually commenced about October 1st. Afterwards the troughs were placed outside where they could be supplied with water from one of the ponds at a temperature of from 65 to 77. This plan worked very well, but the young fish did not grow very fast and it entailed a large amount of work in feeding and caring for the fish. Again some of the small fish about one-half inch long, were brought to the hatchery and taught to take food and a good per centum raised, but they were very small and it was concluded that it would not be practical to raise large numbers in this manner.

One year about six thousand fry three quarters of an inch long, were seined from the spawning pond and transferred to a small pond well filled with vegetable and animal life; two months later this pond was drawn and a little over eight hundred fine bass taken out. This result was too small to be of practical value.

Another year, two of the ponds were fitted with partitions so the breeders could be placed in a small portion of the pond for spawning and at schooling time the young could pass through the screens into the main body of the pond. The water was too low to give this plan a fair trial and the only thing learned was, that the young fry were much larger and fewer in number than usual.

This year the ponds were drawn in June, in hopes that more fish could be saved. Over seven thousand were taken from one pond and placed in another pond which was in good condition and after thirty-six days this pond was drawn and but 2,650 fish found. Some of these were very large—one was measured and found to be six and one-half inches long and weighed two and one-half ounces.

There are several other things that vitally affect the raising of bass, vegetation, natural food, water temperature, supply, etc. Sometimes it seems impossible to get vegetation to grow in a pond and unless there is a good growth of plant life, there will be no fish; that is, no great number and if there is a good growth of water plants, then the prospects for fish are much better.

There are plenty of crayfish in the ponds at Neosho and a fair quantity of other natural food. We also put in top-minnows and try to keep a good stock of food for the fish, but so far have failed to raise fingerling bass in the numbers desired.

One thing that has hindered the work, has been the fact that we have been almost constantly working at the ponds and grounds to get them in shape for good work and we are now getting them in that condition. The water supply, also, has been deficient at times and that has affected the work.

I have always been of the opinion, that the sooner the young fish could be taken from the ponds and placed in small nursery pools or troughs, where they can be constantly under supervision and easily kept sorted, the more fish can be raised. Mr. Leary of the Texas station, is working on this line with excellent results. This plan means that there must be plenty of natural food for the young fry until they can be taught to take the artificial food.

In fact the greatest failure in the raising of bass, is the failure to raise natural food in sufficient quantities at the right time, for the young fry. There is never any difficulty in getting large numbers of eggs and fry, and if the fish were distributed when they were schooling or even when one inch long, there would not be much difficulty in sending them out in large numbers. But the great problem is to prevent their eating each other before they are large enough to take artificial food.

If all the breeders in one pond would spawn at one time so the young would be practically all one size, then the danger of cannabalism would be much lessened. A superintendent of one of the state commissions told me that he had accomplished this by holding the breeders in spring water, at even temperature, all winter, then placing them in the breeding ponds ten days or two weeks before spawning, and they all spawned at once. Well this sounded alluring and I experimented with a few fish, with the result of another failure to add to the list—these fish did not spawn at all that year. But "Hope springs eternal" and next year we hope to raise a large crop of large mouth black bass.

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Cole, Leon J., Ann Arbor, Mich.
Collins, Hon. J. C., Providence, R. I.
Cooper, E. A., Cold Spring Harbor, New York.
Corliss, C. S., Gloucester, Mass.
Coulter, A. L., Charlevoix, Mich.
Crook, Abel, 99 Nassau Street, New York.
Crosby, H. F., 30 Broad Street, New York.
Curtis, J. M., Cleveland, O.
Dale, J. A., York, Pa.
Davis, E. A., Bethel, Vt.
Davis, Horace W., Grand Rapids, Mich.
Davis, B. H., Palmyra, N. Y.
Davis, Hon. George B., Utica, Mich.
Dean, Herbert D., United States Fish Commission, Neosho, Mo.
Demuth, H. C., 144 E. King Street, Lancaster, Pa
DeNyse, Washington I., Gravesend Beach, Borough of Brooklyn, N. Y.
De Rocher, Jas. D., Nashua, N. H.
Dickerson, Freeman B., Detroit, Mich.
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Downing, S. W., Put-in-Bay, O.
Doyle, E. P., Port Richmond, N. Y.
Dublee, J. Clyde, Williamsport, Penn.
Dunlap, I. H., United States Fish Commission, Washington, D. C.
Ebel, Hon. F. W., Harrisburg, Pa.
Edwards, Vinal N., Woods Hole, Mass.
Ellis, J. Frank, United States Fish Commission, Washington, D. C.
Evarding & Farrell, Messrs., Portland, Ore.
Everman, Prof. Barton W., United States Fish Commission, Washington, D. C.

Fearing, Hon. D. B., Newport, R. I.
Filkins, B. G., Northville, Mich.
Fox, Captain J. C., Put-in-Bay, O.
Frook, John E., Paris, Mich.
Frothingham, H. P., Mount Arlington, N. J.
Fullerton, Samuel F., St. Paul, Minn.
Gavitt, W. S., Lyons, N. Y.
Gebhardt, A. E., Secretary Oregon Fish and Game Association, Salem, Ore.
Geer, Dr. E. F., St. Paul, Minn.
Geer, E. H., Hadlyme, Conn.
George, Hon. A. F., Swanton, Md.
Gilmore, Col. Chas., Swanton, Vt.
Gortz, A. F., Chicago, Ill.
Green, Dr. D. W., Ohio Fish and Game Commission, Dayton, O.
Greene, Myron, Franklin, Vt.
Griffith, S. L., Danby, Vt.
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Hahn, Captain E. E., Woods Hole, Mass.
Haley, Caleb, Fulton Market, New York.
Hamilton, Robert, Greenwich, N. Y.
Hampton, F. T., Hill City, Tenn.
Hamsdale, Frank, Madison, Wis.
Handy, L. B., South Wareham, Mass.
Hansen, G., Osceola Mills, Wis.
Harris, J. N., Fulton Market, New York.
Hartley, R. M., 627 Walnut Street, Philadelphia, Pa.
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Henshall, Dr. James A., Bozeman, Montana.
Hill, John L., 115 Broadway, New York.
Hogan, J. J., La Crosse, Wis.
Hogue, William F., Marion, Ala.
Holden, H. S., Syracuse, N. Y.
Hoxie, Chas. A., Carolina, R. I.
Hoxie, J. W., Carolina, R. I.
Howell, John H., 124 Grover Street, Auburn, N. Y.
Hubbard, Waldo F., Nashua, N. H.

Hughes, Frank L., Ashland, N. H.
Hulff, J. H., Norfolk, Neb.
Hunsaker, W. J., Detroit, Mich.
Huntington, L. D., New Rochelle, N. Y.
Hurlbut, H. F., East Freetown, Mass.
Hutchinson, E. S., Washington, D. C.

James, Dr. Bushrod W., n. e. cor. Eighteenth and Green Streets, Philadelphia, Pa.
Jennings, G. E., *Fishing Gazette*, 203 Broadway, New York.
Jensen, Peter, Escanaba, Mich.
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Johnson, S. M., Union Wharf, Boston, Mass.
Jones, Alexander, Erwin, Tenn.
Jones, Col. James E., Director of Aquarium, Battery Park New York City.
Jones, Dr. O. L., 116 West Seventy-second Street, New York.
Joseph, D., Columbus, Ga.
Joslin, Hon. C. D., Detroit, Mich.

Kashiwa, A. M., Seattle, Wash.
Kauffmann, S. H., *Evening Star*, Washington, D. C.
Keller, H. N., California Fish Commission, Santa Monica, Cal.
Kelly, P., 346 Sixth Avenue, New York.
Kennedy, Edwin M., Ohio Fish and Game Commission, McConnellsville, O.
Kendall, Dr. William C., United States Fish Commission, Washington, D. C.
Kenyon, A. W., Usquepaugh, R. I.
Kerr, Captain J. R., Pittsurgh, Pa.
Kiel, W. M., Tuxedo Park, N. Y.

Lamkin, J. Bayard, Bullochville, Ga.
Landers, E. T., Hopeville, Ga.
Lane, George F., Silver Lake, Mass.
Lawton, Col. J. P., Columbus, Ga.
Leach, G. C., 1516 Locust Street, St. Louis, Mo.
Leary, John L., United States Fish Commission, San Marcos, Tex.
LeGettee, K., Centenary, S. C.

Lewis, Charles E., Chamber of Commerce, Minneapolis, Minn.

Locke, E. F., Woods Hole, Mass.

Lovejoy, Samuel, Bullochville, Ga.

Lydell, Dwight, Mill Creek, Mich.

McGowan, Hon. H. P., 108 Fulton Street, New York.

Mallory, Chas., Burling Slip, New York.

Mancha, H. H., Northville, Mich.

Manning, W. W., Marquette, Mich.

Mansfield, H. B., Lieutenant Commander United States Navy, 368 Hancock Street, Brooklyn, N. Y.

Manton, Dr. W. P., Detroit, Mich.

Marks, H. H., Sault Ste. Marie, Mich.

Marks, J. P., Paris, Mich.

Marsh, M. C., Washington, D. C.

Mathewson, G. T., Thompsonville, Conn.

May, W. L., Omaha, Neb.

Mead, Prof. A. D., Brown University, Providence, R. I.

Meehan, W. E., *Public Ledger*, Philadelphia, Pa.

Merritt, F. H. J., Altamont, N. Y.

Merrill, M. E., St. Johnsbury, Vt.

Mershon, W. B., Saginaw, Mich.

Miller, Frank, Put-in-Bay, O.

Miller, Geo. F., Put-in-Bay, O.

Miller, W. S., Gallion, O.

Milliken, Dr. J. D., United States Fish Commission, Woods Hole, Mass.

Mills, G. F., Carson City, Nev.

Mitchell, Prof. Irving M., Milwaukee, Wis.

Mitchell, John A., Columbus, Ga.

Monroe, Otis, Mill Creek, Mich.

Moody, G. C., Mill Creek, Mich.

Moore, Chas. H., Detroit, Mich.

Morgan, H. A., Baton Rouge, La.

Morrell, Daniel, Hartford, Conn.

Morse, Grant M., Portland, Mich.

Morton, W. P., Providence, R. I.

Mosher, Stafford, Fort Plain, N. Y.

Mullett, R. M., United States Fish Commission, Washington, D. C.

Mussey, George D., Detroit, Mich.

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Nevin, James, Madison, Wis.

North, Paul, Ohio Fish and Game Commission, Cleveland, Ohio.

Oberfelder, R. S., Sidney, Neb.

O'Brien, W. J., South Bend, Neb.

O'Connor, E. M., Savannah, Ga.

O'Hage, Dr. Justus, St. Paul, Minn.

O'Malley, Henry, Baker, Washington.

Orr, W. J., Bay Port, Mich.

Osborn, Wm., Duluth, Minn.

Page, P. W., West Summit, N. J.

Palmer, W. A., Buchanan, Mich.

Parker, Dr. J. C., Grand Rapids, Mich.

Parker, W. H., Lac la Peche, Quebec, Canada.

Paxton, Thomas B., Ohio Fish and Game Commission, Cincinnati, O.

Peabody, George F., Appleton, Wis.

Pearce, Caption T. C., United States Fish Commission, Washington, D. C.

Peck, Hon. Stephen, Warren, R. I.

Pike, Robert G., Middletown, Conn.

Plumb, Charles, Mill Creek, Mich.

Powell, W. L., Harrisburg, Pa.

Powers, J. A., Lansingburg, N. Y.

Powers, John W., Big Rapids, Mich.

Prather, J. Hub, Lexington, Ky.

Prendergast, Charles F., 1420 Lincoln Street, Savannah, Ga.

Preston, Hon. John L., Port Huron, Mich.

Preston, Dr. Henry G., 98 Lafayette Square, Brooklyn, N. Y.

Proctor, Hon. Redfield, Proctor, Vt.

Rathbone, Wm. F., D. & H. R. R., Albany, N. Y.

Rathbun, Richard, Smithsonian Institution, Washington, D. C.

Ravenel, W. DeC., United States Fish Commission, Washington, D. C.

Reighard, Prof. Jacob E., University of Michigan, Ann Arbor, Mich.

Richards, G. H., Boston, Mass.

Roberts, A. D., Woonsocket, R. I.

Robinson, W. E., Mackinaw City, Mich.

Robinson, A. H., St. Johnsbury, Vt.

Rodgers, Frank A., Grand Rapids, Mich.

Rodgers, J. L., Ohio Fish and Game Commission, Columbus, Ohio.

Rogers, J. M., Chicago, Ill.

Root, Henry T., Providence, R. I.

Rosenberg, Albert, Kalamazoo, Mich.

Ruge, John G., Apalachicola, Fla.

Russell, Henry, Detroit, Mich.

Sampson, E. R., care of New York Aquarium, Battery Park, New York City.

Sanborn, F. G., 612-622 California Street, San Francisco, Cal.

Saunders, Dr. H. G., Chattanooga, Tenn.

Scarborough, L. A., Columbus, Ga.

Schley, Dr. F. V., Columbus, Ga.

Schute, John A., Havana, Ill.

Schweikart, Walter, Detroit, Mich.

Seagle, Geo. A., Wytheville, Va.

Self, E. M., Bullochville, Ga.

Sellers, M. G., Philadelphia, Pa.

Sexton, Cramer, Murfreesboro, Tenn.

Sherwin, H. A., 100 Canal Street, Cleveland, O.

Simons, Max, Columbus, Ga.

Singleton, James H., Woonsocket, R. I.

Smith, Henry D., Appleton, Wis.

Smith, Jay, care of J. W. Marston & Co., Lewis Wharf, Boston, Mass.

Smith, L. H., Algona, Iowa.

Smith, Dr. Hugh M., United States Fish Commission, Washington, D. C.

Smith, Capt. J. A., Woods Hole, Mass.

Snyder, Dr. F. B., Ashtabula, Ohio.
Solman, Alden, South Norwalk, Conn.
Southwick, J. M. K., Newport, R. I.
Spencer, L. B., Supt. Aquarium, 37 W. 128th Street, New York City.
Spensley, Calvert, Mineral Point, Wis.
Springer, F. H., Columbus, Ga.
Starbuck, Alexander, Cincinnati, O.
Starr, W. J., Eau Claire, Wis.
Stelle, G. F., Chicago, Ill.
Sterling, J. E., Crisfield, Md.
Stewart, Chas. E., Westerly, R. I.
Stewart, A. T., Northville, Mich.
Stone, Livingston, Cape Vincent, N. Y.
Stranahan, J. J., Bullochville, Ga.
Stranahan, F. A., Cleveland, O.
Stranahan, F. F., Cleveland, O.
Stranahan, H. B., Cleveland, O.
Suthers, Frank, Madison, Wis.
Sykes, Arthur, Madison, Wis.
Sykes, Henry, Bayfield, Wis.
Tawes, J. C., Crisfield, Md.
Taylor, A. R., 318 Main Street, Memphis, Tenn.
Thayer, W. W., 234 Joseph Campau Avenue, Detroit, Mich.
Thomas, Henry G., Stowe, Vt.
Thompson, Carl G., 78 Henry Street, Huntington, Ind.
Thompson, W. T., Nashua, N. H.
Thompson, W. P., 112 Bread Street, Philadelphia, Pa.
Tinker, E. F., St. Johnsbury, Vt.
Titcomb, John W., United States Commission of Fish and Fisheries, Washington, D. C.
Townsend, Chas. H., United States Fish Commission, Washington, D. C.
Trumpour, D. A., Bay City, Mich.
Tubbs, Frank A., Neosho, Mo.
Tucker, Edmund St. George, Bedford Row, Halifax, N. S.
Tulian, Eugene A., Leadville, Colo.
Turner, J. C., Columbus, Ga.

VanDusen, Hon. H. G., Master Fish Warden of Oregon, Astoria, Ore.

Vincent, W. S., United States Commission of Fish and Fisheries, Washington, D. C.

Vogelsang, Alexander T., Mills Building, San Francisco, Cal.

Walker, Bryant, Detroit, Mich.

Wallett, W. H., Put-in-Bay, O.

Walters, C. H., Cold Spring Harbor,, N. Y.

Ward, Prof. H. B., Lincoln, Neb.

Webb, W. Seward, Forty-fourth Street and Vanderbilt Avenue, New York.

Wentworth, Edwin, United States Fish Commission, Nashua, N. H.

Wentworth, Nathaniel, Hudson Centre, N. H.

Weed, W. R., Potsdam, N. Y.

Wetherbee, W. C., Port Henry, N. Y.

Wheeler, Chas. Stetson, Hobart Building, San Francisco, Cal.

Whish, John D., Secretary, Forest, Fish and Game Commission, Albany, N. Y.

White, R. Tyson, 320 Bridge Street, Brooklyn, N. Y.

Wilbur, H. O., 235 Third Street, Philadelphia, Pa.

Wilbur, P. H., Little Compton, R. I.

Willard, Chas. W., Westerly, R. I.

Willetts, J. C., 40 Wall Street, New York.

Williams, J. A., St. Johnsbury, Vt.

Wilson, C. H., Glens Falls, N. Y.

Wilson, S. H., Cleveland, O.

Winn, Dennis, Nashua, N. H.

Wires, S. P., Lester Park, Duluth, Minn.

Wisner, J. Nelson, Jr., United States Fish Commission, Washington, D. C.

Wood, C. C., Plymouth, Mass.

Woodruff, C. B., Columbus, Ga.

Wride, Geo. A., Grindstone City, Mich.

Zalsman, Philip G., Paris, Mich.

Zweighapt, S., Deer Park, Haines Falls, N. Y.

HONORARY.

Borodine, Nicholas, Delegate of the Russian Association of Pisciculture and Fisheries, Uralsk, Russia.

Fish Protective Association of Eastern Pennsylvania, 1020 Arch Street, Philadelphia, Pa.

Lake St. Clair Shooting and Fishing Club, Detroit, Mich.

New York Association for the Protection of Fish and Game, New York City.

Peck, Hon. Geo. W., Milwaukee, Wis.

South Side Sportsmen's Club, Oakdale, L. I., N. Y.

Sweeny, Dr. R. O., Lester Park, Duluth, Minn.

The President of the United States.

The Governors of the Several States.

Woodmont Rod and Gun Club, Washington, D. C.

CORRESPONDING.

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

Armistead, J. J., Dumfries, Scotland.

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

Brady, Thos. F., Esq., Inspector of Fisheries, Dublin Castle, Dublin, Ireland.

Calderwood, W. L., Esq., Inspector of Salmon Fisheries, Edinburgh, Scotland.

Feddersen, Arthur, Copenhagen, Denmark.

Feilding, J. B., Upper Downing, Holywell, North Wales.

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

Ito, K., Member of Fisheries Department of Hokkaido and President of the Fisheries Society of Northern Japan, Sapporo, Japan.

Jaffe, S., Osnabruck, Germany.

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

Landmark, A., Inspector of Norwegian Fresh Water Fisheries, Bergen, Norway.

Lundberg, Dr. Rudolph, Inspector of Fisheries, Stockholm, Sweden.

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

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

Olsen, O. T., Grimsby, England.

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

Senior, William, London, England.

Smitt, Prof. F. A., Stockholm, Sweden.

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

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

Trybom, Dr. Filip, Stockholm, Sweden.

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

Wattel, M. Raveret, Secretary of the Societe d'Acclimation, Paris, France.

RECAPITULATION.

Active	332
Honorary	54
Corresponding	24
Total membership	410

CONSTITUTION.

(As amended to date).

ARTICLE I.

NAME AND OBJECTS.

The name of this Society shall be American Fisheries Society. Its objects 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 all 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 one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar 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.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

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 office until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an 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.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Standing Committees.
5. Committees appointed by the President.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—a. In the reading of papers preference shall be given to members present.
b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society).

7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

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 said meeting.

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED THREE

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-second Annual Meeting

JULY 21, 22 AND 23, 1903,

At Woods Hole, Mass.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1903.

Officers for 1903-1904.

President...............FRANK N. CLARK, Northville, Mich.
Vice-President...........DR. TARLETON H. BEAN, St. Louis
Recording Secretary......GEORGE F. PEABODY, Appleton, Wis.
Corresponding Secretary, W. DE C. RAVENEL, Washington, D. C.
Treasurer...................C. W. WILLARD, Westerly, R. I.

EXECUTIVE COMMITTEE.

E. W. BLATCHFORD, *Chairman,* Chicago, Ill.
C. C. WOOD, Plymouth, Mass.
R. D. HUME, San Francisco, Cal.
M. E. MERRILL, St. Johnsbury, Vt.
J. L. LEARY, San Marcos, Tex.
E. A. TULIAN, Leadville, Colo.

INDEX.

PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, July 21st, 1903.

Convention called to order at 12 m. by the President, Mr. George M. Bowers, of Washington, D. C.

The registered attendance at the meetings of the Society is as follows:

Allen, George R., Roxbury, Vt.
Atkins, Charles G., East Orland, Me.

Bean, Hon. Tarleton H., St. Louis, Mo.
Beeman, Henry W., New Preston, Conn.
Bentley, B. Court, Westerly, R. I.
Blatchford, E. W., Chicago, Ill.
Boardman, W. H., Central Falls, R. I.
Bower, Seymour, Detroit, Mich.
Bowers, George M., Washington, D. C.
Bowman, W. F., Woods Hole, Mass.
Bryant, Edwin E., Madison, Wis.

Carter, E. N., St. Johnsbury, Vt.
Champlin, John H., Westerly, R. I.
Clark, Frank N., Northville, Mich.
Corliss, C. G., Gloucester, Mass.

Davis, E. A., Bethel, Vt.
Dean, H. D., Neosho, Mo.
Downing, S. W., Put-in-Bay, O.

Gorham, F. P., Woods Hole, Mass.
Graham, A. R., Berkeley, Mass.
Gray, George M., Woods Hole, Mass.
Green, Chester K., Washington, D. C.

Geer, E. Hart, Hadlyne, Conn.
Handy, L. B., South Wareham, Mass.
Harron, L. G., Washington, D. C.

Henshall, J. A., Bozeman, Mont.
Hubbard, Waldo F., Nashua, N. H.
Hurlburt, H. F., East Freetown, Mass.
Jennings, G. E., New York, N. Y.
Jones, Alexander, Erwin, Tenn.
Lane, George F., Silver Lake, Mass.
Leary, J. L., San Marcos, Tex.
Locke, E. F., Woods Hole, Mass.
Lydell, Dwight, Mill Creek, Mich.
Marsh, M. C., Washington, D. C.
Mathewson, G. T., Thompsonville, Conn.
Millikin, Dr. J. D., U. S. Fish Com., Woods Hole, Mass
Morton, William P., Providence, R. I.
Nevin, James, Madison, Wis.
Peabody, George F., Appleton, Wis.
Pike, Robert G., Middletown, Conn.
Race, E. E., Green Lake, Me.
Ravenel, W. DeC., Washington, D. C.
Robinson, Robert K., White Sulphur Springs, W. Va.
Root, Henry T., Providence, R. I.
Seagle, George A., Wytheville, Va.
Smith, Capt. J. A., Woods Hole, Mass.
Stone, Livingston, Cape Vincent, N. Y.
Thompson, W. T., Nashua, N. H.
Titcomb, John W., Washington, D. C.
Tulian, E. A., Leadville, Colo.
Waterhouse, Everett Marshall, Providence, R. I.
Whish, John D., Albany, N. Y.
White, R. Tyson, New York City.
Willard, C. W., Westerly, R. I.
Wires, S. P., Duluth, Minn.
Wood, C. C., Plymouth, Mass.
Worth, S. G., Edenton, N. C.

During the several sessions the following gentlemen were elected to membership in the Society:

Atwood, Anthony, 75 Watercst Street, Plymouth, Mass.
Bastedo, S. T., Toronto, Canada.

Beardsley, A. E., M. S., Greeley, Colo.
Beason, W. H., Nashua, N. H.
Bennett, Charles P., Secretary of State, Providence, R. I.
Bense, W. E., Port Clinton, Ohio.
Bentley, B. Court, Westerly, R. I.
Bogle, C. M., Editor Pacific Fisherman, Seattle, Wash.
Bowman, W. F., Breakwater Hotel, Woods Hole, Mass.
Britton, F. H., St. Louis, Mo.
Campbell, S. H., Laramie, Wyo.
Champlin, John H., Westerly, R. I.
Chandler, Horatio, Kingston, Mass.
Clark, Charles C., General Treasurer Office, Providence, R. I.
Clark, Walton F., Westerly, R. I.
Cone, Moses H., Flat Top Manor, Bowling Rock, N. C.
Degler, F. A., Cheat Bridge, Randolph County, W. Va.
Ferry, C. H., Room 1720 Old Colony Building, Chicago, Ill.
Goldsborough, E. L., U. S. F. C., Washington, D. C.
Gordon, Jack, Paris, Tex.
Graham, A. R., Berkeley, Mass.
Grant, R. P., Clayton, N. J.
Gray, George M., Woods Hole, Mass.
Guard, J. E., Bullochville, Ga.
Harron, L. G., U. S. F. C., Washington, D. C.
Hayes, J. R., Detroit, Mich.
Hobart, T. D., Pampa, Gray County, Tex.
Hume, R. D., 421 Market Street, San Francisco, Cal.
Ingraham, E. W., Oil City, Pa.
Isaac, George H., U. S. F. C., Washington, D. C.
Jewett, Stephen S., Laconia, N. H.
Johnson, M. D., F. M., 117 Beacon Street, Boston, Mass.
Johnson, George H., Riverside, R. I.
Johnson, R. S., Manchester, Iowa.
Knight, Prof. A. P., Queens University, Kingston, Can.
Lambert, E. C., Manchester, N. H.
Lambson, G. N., U. S. F. C., Baird, Colo.
Latchford, Hon. F. R., Toronto, Canada.
Lewis, C. C., U. S. F. C., Washington, D. C.
Mahone, A. H., White Sulphur Springs, W. Va.

Marshall, F. M., Washington, D. C.
McDonald, A. G., care A. Booth & Co., Detroit, Mich.
McDougal, J. M., Gunnison, Colo.
Parker, J. Fred, Assist. Secretary of State, Providence, R. I.
Purdum, James, K. P. P., Woods Hole, Mass.

Race, E. E., Green Lake, Me.
Randall, G. W., Plymouth, Mass.
Reed, C. A., Santa Cruz, Cal.
Rhodes, G. W., Lincoln, Neb.
Ripple, Robert, Woodruff, Wis.
Robinson, Robert K., White Sulphur Springs, W. Va.
Rooney, James, Ft. Stockton, Tex.

Sherwood, George H., American Museum, New York City.
Shurtleff, Merrill, Lancaster, N. H.
Simmons, Walter C., Providence, R. I.
Slade, George P., 309 Broadway, New York City.
Stevens, Arthur F., 227 West Grand Street, Elizabeth, N. J.
Stone, Arthur F., St. Johnsbury, Vt.

Teal, J. N., Portland, Oregon.
Thomas, H. G., Stowe, Vt.
Thompson, William H., Alexandria Bay, N. Y.
Tucker, Dr. Ernest F., The Marquam, Portland, Oregon.
Turner, Avery, Amarillo, Tex.

Veeder, John J., Woods Hole, Mass.

Wallich, Claudius, U. S. F. C., Oregon City, Oregon.
Walsh, Joseph, Woods Hole, Mass.
Warner, S. M., Glen Farm, Dorset, Vt.
Waterhouse, Rev. E. M., Providence, R. I.
Wolf, Herman T., 489 The Bourse, Philadelphia, Pa.
Worth, S. G., Edenton, N. C.
Wride, George A., Grindstone City, Mich.
Wykoff, C. F., 280 Broadway, New York.

President Bowers: Gentlemen, you are now called to order. The usual formalities will be dispensed with. I hardly think under the conditions that it is necessary to have any one to induct the present president into office, as in the absence of Gen. Bryant it will be necessary to postpone that event at least.

The President then read his address, which is as follows:

Washington, D. C., July 17, 1903.

Members of the American Fisheries Society:

Gentlemen:—

As President of this Society I greet you and wish you well, and as the head of the Bureau of Fisheries I welcome you to Woods Hole and this building where you are met. To address you thus in dual capacity and in this place, made memorable by former successful meetings and by its association with the name which we all honor and to which we shall this year pay visible and enduring tribute, is a compliment which I appreciate and value.

It is an honor significant of the relations which have always existed between this Society and the Fish Commission. The two are twin brothers of the fisheries conditions of thirty-two years ago and the enthusiasm and hopefulness with which they were met. At that time it had become increasingly obvious that some of our fisheries were being depleted to a degree which would soon make futile their further pursuit for sport or profit. It was clear that man had destructively disturbed nature's pre-existing balance and that man alone would re-establish it. Both among those directly interested in the fisheries by reason of the sport or profit derivable from them and in legislative bodies, the adoption of systematic and vigorous measures for the restoration of the fisheries was gaining advocates.

There was existent in the country at that time a little body of progressive men, similar in character to that which now constitutes the membership of this Society, who saw clearly and acted wisely. Some of them, appreciating fully the value of an organization holding stated meetings for the exchange of experience and information, formed themselves into this Society which has since its founding held a high place in the annals of American fish culture and all that makes for the good of the fisheries. At the same time the general agitation of the subject and the representations of Professor Baird secured from Congress the appointment of a commissioner and a small appropriation for the purpose of carrying on certain investigations upon the causes of the decrease of fishes and remedies therefor. One of the earliest acts of this Society was to aid in procuring increased appropriations for this purpose, and from that time to this the American Fisheries Society and the United States Fish Commission have been in close and mutually profitable relations.

It was fortunate for the Fish Commission that there was available at the time of its inception a master mind whose breadth, learning, and disinterestedness had the respect of all interested in the work of rescuing the fisheries from the conditions in which they were sinking. With a reputation already world-wide, and securing and assuming as a labor of love the burden of organizing and directing the new Commission, no taint of self-seeking could be attributed to his efforts at that time. Fish culture was not yet divested of its novelty and skepticism was still unallayed. Scientific knowledge was less extended than now and but little accurate knowledge was attainable concerning the fisheries and the conspicuous conditions upon which they depended. To the acquirement of such information, to the demonstration of the value of fish culture on a large scale, the peculiar development and extension of improved methods, Professor Baird devoted himself, and he was ably assisted by this Society as a whole and by some of its members individually. Professor Baird's administration was long and able, and under him the Commission passed through infancy to advanced knowledge and sturdy manhood which received the respect and admiration of the world.

Since the foundation of these two organizations the United States has taken a conspicuous place in all matters relating to the fisheries, and American methods and investigations are recognized as criteria for foreign emulation, study and profit. Hatcheries have multiplied and improved and the fisheries work of the Federal Government has grown beyond the hopes and expectations of its projectors. Congress has pursued a liberal policy, and while all that has been asked for has not been granted, the experience of the past five years indicates that the work which is being carried on meets with the approval of Congress and their confidence is expressed in increased appropriations. President Roosevelt's interest in all that pertains to the work in which this Society and the Bureau of Fisheries is engaged is well known and is a stimulus to governmental activities in these lines. Secretary

Cortelyou is also favorably disposed and it is assured that the good work independently carried on under the Fish Commission in the past will be continued and extended under its new status as the Bureau of Fisheries of the Department of Commerce and Labor.

During the past year the Fish Commission, in addition to its usual extensive fish-cultural operations, is credited with important investigations in Hawaii, Alaska, and in the several parts of the United States. Experiments are now under way, or about to be undertaken, which it is believed will lead to the development of practical methods of culture of sponges, terrapin, green turtle, and frog, and improvement in the methods of oyster culture. At the present time there is in course of erection a station to be devoted to the lobster and lobster culture, according to a system developed jointly by the Fish Commission of the United States and the Rhode Island State Fish Commission.

In the past thirty-two years much has been done but much remains. The possibility for originating investigations in fish culture and its cognates are not yet exhausted. An accurate knowledge of causes and diagnoses of the treatment of diseases which attack fish in confinement is urgently needed, and, as you have been made aware by the paper presented last year and the one announced for the present meeting, this problem is now being systematically attacked. Another need is the study of nutrition of young fishes and the development of a more rational method of feeding. Intensive production of the natural food of certain species is in places almost a necessity and the discovery and development of a cheap and practical system is highly desirable A score of other desiderata might be mentioned and they will suggest themselves to those of you who are practically engaged in fish culture or research. It is a stimulus to such research and investigations that this Society and these meetings are chiefly valuable.

We have an interesting and instructive program, from the consideration of which I shall no longer detain you. I trust that this meeting will be pleasant and profitable and that we shall go from it fortified to carry to greater perfection the various works upon which we are severally engaged.

(The address was received with great applause.)

President: In the absence of the chairman and treasurer of the committee in charge of the memorial services concerning the unveiling of a memorial to Prof. Baird, I deem it proper at this time that a committee should be appointed by the American Fisheries Society to assume and take control of this whole matter. I therefore suggest that Mr. Frank N. Clark, and Mr. W. De C. Ravenel, and Mr. E. F. Locke, be named as members of that committee, subject to the approval of the Society.

Secretary: I have a letter from Mr. Blackford in which he says: "I am so ill this week that I can hardly write intelligibly," and he apologizes for not being able to be present, and has turned over the matter of the memorial services entirely to this meeting, and encloses a check which might perhaps be considered later, for a balance that has inured.

President: I found, in looking over some memoranda of Dr. Smith's, that arrangements had been made with Prof. Brooks of Johns Hopkins University to deliver this address, and I communicated with Prof. Brooks a week or so ago, and he gave me to understand that he would be here tomorrow. It would be necessary, however, under a previous arrangement made with Dr. Smith, for the Society to defray his expenses. I think that was the arrangement.

Secretary: That is the understanding.

President: That is, out of the memorial fund already provided for?

Secretary: Yes, and whatever money is left will probably inure to the coffers of the American Fisheries Society.

Mr. Titcomb: I move that we take up as the next business, the naming of the various committees usually appointed, and add to those of last year, a committee on program, the duty of that committee to be to arrange for time of meetings, and the time for recreation, which will go with the meetings hand in hand. As many of you know, we can hold meetings while we are on the boat, going to any place we wish to visit; and some of the proprietors of commercial hatcheries here, desire the Society to visit their places.

Another committee I would suggest, is a committee on papers, who should receive the papers, ascertain just how many there are besides those that are on the printed program, and arrange for the order of reading, so that it can be annouced in advance, giving those who have special interest in one line of work an opportunity to be present at that meeting, if they cannot attend all. In making these motions I request you to omit me from any of those committees.

President: Your suggestion is a good one, but I had intended that the committee just appointed should be the committee on program, and if there be no objection it will be so considered.

Mr. Titcomb: That is entirely satisfactory.

President: In regard to the committee on papers, I will put that motion.

(Unanimously carried).

The President appointed on that committee Mr. Titcomb Dr. Bean, and Mr. Seymour Bower.

The following telegrams were received and greeted with applause:

Washington, D. C., July 21.

To Hon. George M. Bowers, President,
Society of Fisheries.

Accept for yourself and your associates my best wishes for a most interesting and successful meeting.

GEORGE B. CORTELYOU, Secretary,
Department of Commerce and Labor.

Boston, Mass., July 21.

To Commissioner of Fisheries,
Woods Hole.

Will be at Woods Hole this afternoon. W. K. BROOKS.

The Secretary's report was then called for.

Secretary: The Secretary's report is embodied in the transactions for the last year, and the only report that the Secretary has to make in addition is that during the year the work of the Secretary has been very much helped by the United States Fish Commission in furnishing a list of some 400 names of eligible candidates for membership, to whom a circular letter has been sent, and we have added approximately about fifty new members who have sent in their request for membership, and usually with a very grateful acknowledgement of the courtesy of the invitation extended to them; and some of them will be here I think. There is nothing new that the Secretary has to report, except to turn over to the Society a number of letters from different parts of the country from those who acknowledge the value of this Society, its work and influence, and wish it Godspeed. I do not think there is anything else that the Secretary has to report. The treasurer reports the amount of money received from these new members.

(Secretary's report accepted).

Treasurer's report called for, which was presented as follows, read, and at Mr. Willard's request referred to the auditing committee, after being received:

To the American Fisheries Society
of the United States of America:

Gentlemen:—

I herewith submit my annual report as Treasurer from August 5th, 1902, to July 21st, 1903:

RECEIPTS.

Balance in treasury	$101.14	
Yearly dues and admission fees	278.00	
Life membership dues	30.00	
Interest on balances	1.50	
		$410.64

EXPENDITURES.

1902.			
Aug. 12.	New ledger	$ .75	
Aug. 12.	300 stamped envelopes	6.36	
Aug. 22.	100 stamped envelopes	2.12	
Oct. 10.	100 stamped envelopes	2.12	
Sept. 16.	H. D. Goodwin, stenographer	102.00	
Dec. 3.	Post Publishing Co. (By Secretary)	152.60	
Dec. 3.	G. F. Peabody, Secretary	27.83	
1903.			
May 27.	Receipts	.75	
May 27.	100 stamped envelopes	2.12	
June 27.	Receipt books and Ex.	5.75	
June 29.	100 stamped envelopes	2.12	
July 17.	George F. Peabody, Secretary	43.47	
		$347.99	
Balance cash on hand		62.65	
			$410.64

Depository of funds, Manufacturers Trust Company, Providence, R. I.

C. W. WILLARD, Treasurer.

Westerly, R. I., July 21st, 1903.

Secretary: I would like to bring up a matter now perhaps for the meeting to decide upon. I think that whoever occupies the position of secretary next year, should have an appropriation for the expenses of the office. There is a great deal of clerical work, and very few men have the time to give it, if they have anything else to do, and my stenographer has spent so much extra time at it, that I have paid her $25 extra each year, which I am glad to contribute, but I think it is well that no one should be burdened with that, and I think there should be as large an appropriation as that to pay for the extra work, of which there is a great deal. I have sent out nearly 250 letters relating to the business of the Society. During the last year I had quite a large correspondence, receiving letters constantly, and my stenographer has had that extra work, besides the editing of the report, and it is quite a task too for the Secretary to collate all the material, and do the proof reading and all that sort of thing, and I would respectfully suggest and move that the Society appropriate a sum not less than $25 to the Secretary to pay his expenses.

Motion seconded and unanimously carried.

Secretary: It is understood that this is not retroactive, but for the future.

President: That will be understood.

The President then appointed the following committees:

Committee of five on nomination of officers: Mr. Seymour Bower, Dr. J. A. Henshall, Mr. E. N. Carter, Mr. R. T. White, and Mr. John D. Whish.

Committee of three on time and place of next meeting: Mr. John W. Titcomb, Mr. W. P. Morton, and Mr. John L. Leary.

Auditing committee: Mr. S. G. Worth, Mr. H. D. Dean, and Mr. W. H. Boardman.

Mr. Titcomb: I can bring in some specimens of bass to start the bass question, if you wish me to do so. I have no paper on the subject.

Mr. F. N. Clark: Do not start the bass question now before dinner. (Laughter).

If you will allow the committee on program to confer, we will submit a program to you before you adjourn.

Mr. Titcomb: The committee on time and place will be very glad to hear from all those who are interested in that question, at any time after this meeting.

For the committee on papers, I will request all those who have papers to submit them to us as soon as convenient, so that the various subjects can be arranged to come together.

Mr. Charles G. Atkins: Do I understand that Mr. Titcomb desires to have the manuscripts submitted?

Mr. Titcomb: We would be glad to see them.

Mr. Clark: The program committee feel they have not time to prepare a complete program at this time, and therefore beg leave to submit the following partial report, in regard to the program for today, and this evening will submit a full report of the program for the several days doings, including the memorial exercises. We suggest that the Society meet at 2 o'clock on the Fish Hawk, and for an hour take up the papers on bass and discuss them, and that at 5 o'clock adjourn for evening dinner, to meet again at 8 o'clock in this room for further discussion of the bass papers (if they have not been completed), and then take up the trout papers.

Report unanimously accepted.

Secretary: I suggest that the report be typewritten and posted.

Mr. Clark: That will be done.

Recess until 2 p. m.

AFTERNOON SESSION, 2:30 O'CLOCK.

Same day, 2:30 p. m., meeting called to order by the President on board the Fish Commission steamer, Fish Hawk.

Roll was called and applications for membership read by Mr. Willard.

Mr. Clark: I move that the names read be elected as members of this Society.

Motion seconded and unanimously carried.

Mr. Clark: The committee on program desire to suggest a change in the program. You will remember, they suggested that papers on the bass question be discussed here on the boat, and as that is a very important subject the committee have decided that on account of the difficulty of discussing these papers on the deck of the boat, it will be better to change the program in that respect, and that papers by Dr. Bartlett on "Angling for Carp," and Mr. Mead, of Providence, Rhode Island, on "Recent Advancement in Lobster Culture," be taken up now. We think the question of bass could be better discussed later.

President: If there are no objections it will be taken as the sense of the meeting that the proposed change of program is acceptable.

(No objections were offered).

Secretary: I would like to present the name of Mr. George B. Cortelyou, Secretary of the Department of Commerce and Labor, to be made an honorary member of this Society.

Motion seconded and unanimously carried amid great applause.

The paper by Mr. S. P. Bartlett, of Quincy, Ill., on "Angling for Carp and Some Hints as to the Best Mode of Cooking," was then read by the Secretary and discussion had upon it.

Mr. T. W. Willard then read a paper by Mr. A. D. Mead of the Commission of Inland Fisheries of Rhode Island on the subject of "Recent Advances in Lobster Culture," and the paper was discussed.

Dr. James A. Henshall then read a paper on "Fish Food," which was discussed.

Mr. Charles G. Atkins then read a paper on "The Live-Food Problem," which was discussed.

At 4:30 p. m. recess was taken until 8 p. m. the same day.

EVENING SESSION, 8:00 O'CLOCK.

At 8 p. m., same day and place, July 21st, 1903, meeting called to order by the President.

Applicants admitted to membership.

The Secretary then read a letter from Mr. J. E. Gunckel, which is as follows:

Toledo, O., July 20th, 1903.

Hon. George F. Peabody, Secretary.

Woods Hole, Mass.

My Dear Sir:—

I very deeply regret my inability to attend the 32nd annual meeting of the American Fisheries Society.

Of all the associations that I belong to none seems to be nearer to me than this society. I have learned to like the members and their methods of cordiality. All I regret is that we haven't more truthful anglers among them. I have tried for many years to instill this important addition to a fisherman's life, to some of the members, but they absolutely refuse to follow example. I know you will have a splendid time and hope to meet you next year.

I enclose one dollar, annual dues for 1903-'04.

This is my busy time of the year with excursions, being a railroad man I can't go so far away from my territory.

Hope the members will not forget.

J. E. GUNCKEL.

Also letter from Mr. J. J. Stranahan, which is as follows:

Bullochville, Ga., July 28th, 1903.

Hon George F. Peabody, Secretary,

American Fisheries Society:

Dear Mr. Peabody:—

I have been so desperately busy that it has been impossible for me to work up a list of new members this year. Will double last one next year

I enclose check for $7.00 to pay for annual dues for

B. Andrews, Columbus, Ga., (think it is erroneously A. Andrews in last year's list).

E. M. Self, Bullochville, Ga.

Samuel Lovejoy, Bullochville, Ga.

J. J. Stranahan, Bullochville, Ga.

And membership fees for

J. E. Guard, Bullochville, Ga.

George H. Isaac, Washington, D. C.

C. C. Lewis, Washington, D. C.

I also enclose my paper on black bass. I have written Mr. John W. Titcomb asking him to read it for me.

My heart and soul is with you all in this meeting and I hope that it will be the best ever held by the society. The commissioner very kindly ordered me to go to the meeting if I could be spared, but it is just out of the question. Yours very truly,

J. J. STRANAHAN.

Also part of letter from Prof. Henry B. Ward:

Lincoln, Neb., July 16th, 1903.

Hon. George M. Bowers,

U. S. Fish Commission, Woods Hole, Mass.:

My Dear Commissioner Bowers:

I regret very much that personal matters will prevent my being present at the meeting of the Fisheries Society, but have sent a paper, which I trust may be of some interest.

With regards, I remain very truly yours,

HENRY B. WARD.

The Program Committee then presented the following program:

PROGRAM.

MEETINGS OF AMERICAN FISHERIES SOCIETY.

WOODS HOLE, MASS., JULY, 1903.

July 21.

12 m.—Assembly Room, Fish Commission Building. Routine business.

2 p. m.—Steamer Fish Hawk. Reading and discussion of papers.

8 p. m.—Assembly Room, Fish Commission Building. Further reading of papers and discussion of same.

July 22.

9:30 a. m.—Assembly Room, Fish Commission Building. Reading and discussion of papers.

2:30 p. m.—Unveiling and dedication of memorial to Prof. Spencer F. Baird.

8:00 p. m.—Assembly Room, Fish Commission Building. Reading and discussion of papers.

July 23.

8:30 a. m.—Steamer Fish Hawk, which will leave Woods Hole for Providence, R. I., at 7:30 a. m. Report of standing and special committees.

Report accepted and adopted.

Mr. Titcomb: The Committee on Papers have to say that it was first suggested that we have the bass papers, but I hear that a good many feel fatigued, and the bass papers are still coming in, and it looked as if there would be a long discussion, and much time taken in reading them; it has, therefore, been suggested that several of the papers, which will not naturally take so much time in discussion, be read this evening. Among those may be mentioned one by Mr. Waldo F. Hubbard on Transportation of Green Brook Trout and Salmon Eggs, relative to the comparison of the two species of eggs with reference to bearing transportation or rough usage; also a paper on the "Striped Bass" by Mr. Daniel B. Fearing of Newport; and in connection with that Mr. S. G. Worth of Edenton, N. C., will have something to say about the success of his work in hatching striped bass for the United States Fish Commission this last spring; also a paper by Mr. John P. Whish of Albany on "Some Facts showing the Commercial Value of Fish Culture in New York State;" and there are several other papers which will be ready in case those do not take up all the time.

Paper by Mr. Waldo F. Hubbard on "Transportation of Green Brook Trout and Salmon Eggs," relative to the capacity of the two species of eggs with reference to bearing transportation or rough usage, was then read and discussed.

Rev. E. M. Waterhouse of Providence, R. I., then read a paper by Mr. D. B. Fearing of Newport, entitled, "Some Early Notes on Striped Bass," which was discussed.

Adjourned to same place July 22nd, 1903, 9:30 a. m.

Wednesday, July 22, 1903.

United States Fish Commission Building, July 22nd, 1903, 9:30 a. m., meeting called to order by the President.

Report of the Secretary in conjunction with the Baird Memorial, presented.

Secretary: There is no regular report of the Baird Memorial Committee, excepting a letter and statement from Mr. Blackford. He encloses a list of subscribers to the Baird Memorial fund, a list of disbursements, and a check for $94.85, being the balance on hand. This is to be used for the expenses of the speakers, etc., at the unveiling. Mr. Blackford is so ill that he cannot be here.

The President then read a letter from Mr. H. M. Smith:

Sendai, Japan, June 17th, 1903.

My Dear Mr. Bowers:

In regard to the Baird memorial exercises to be held during the meeting of the Fisheries Society, I beg to advise you that I placed all the papers and plans in the hands of Mr. E. G. Blackford, the Treasurer. I did not hear from him before leaving Washington, but I suppose he has gone ahead with preparations, contemplating the attachment of the tablet and the covering of the stone with an American flag, address by Prof. Brooks, and perhaps by Mr. Blackford and Mr. Blatchford, and unveiling of the boulder by Vinal Edwards.

I hope the Fisheries Society, under your presidency, will have its most successful meeting, and wish I could be there to help in any possible way to that end.

I trust the new fiscal year will have opened auspiciously for you personally and officially.

Before this reaches you I expect to be on the long homeward journey, the end of which will be most gratifying.

With kindest regards to yourself and family, I am,

Yours sincerely, H. M. SMITH.

The Honorable George M. Bowers,
U. S. Fish Commissioner, and
President of the American Fisheries Society:

There are many people who will be at Woods Hole who never saw Prof. Baird. Permit me to suggest that his portrait in the Wasnington office (my room) be sent on and and hung in the residence.

Mr. Titcomb: The committee have to present first some specimens of oysters from Puget Sound, and these were sent to Mr. O'Mally, with a letter which he has authorized me to open, and Dr. Graham, who is interested in the oyster culture here, and who has been studying the question, has kindly consented to read it, after which if you will ask him questions instead of me, perhaps you will get more information.

Letter from Huntoon Oyster Company regarding samples of native seed oysters taken from Samish Bay, Dagget County, Washington, was read and discussed.

Mr. Titcomb: I move that the thanks of the Society be rendered to the Huntoon Oyster Company through the Secretary for submitting this exhibit, and suggest that if it is possible to obtain a photograph of that webbing with the spat upon it, inasmuch as it seems to be an entirely new method of value to other oyster culturists, one be taken for publication in the report with the letter.

President: Do you think that should be done by the Fisheries Society?

Mr. Titcomb: Either the Commission or the Society.

Secretary: I think the Commission had better do it, furnish me the photograph and I will publish it.

President: That letter asks in a general way for information, and I think it would be more proper to have the Fish Commission do that than to have the expense placed upon the American Fisheries Society.

Resolution of thanks unanimously carried.

President: The next in order will be the report of the Committee on Nomination of Officers.

Mr. Bower: The Committee on Nomination of Officers for this Society for the ensuing year, after due consideration respectfully and unanimously recommend the following candidates:

For President—Frank N. Clark of Michigan.

For Vice President—Dr. Tarleton H. Bean of New York.

For Recording Secretary—George F. Peabody of Wisconsin.

For Corresponding Secretary—W. DeC. Ravenel of Washington.

For Treasurer—C. W. Willard of Rhode Island.

FOR EXECUTIVE COMMITTEE.

E. W. Blatchford, *Chairman*, Illinois.

C. C. Wood, Massachusetts.

R. D. Hume, San Francisco.

M. E. Merrill, Vermont.

J. E. Leary, Texas.

E. A. Tulian, Colorado.

Mr. Titcomb: I move that the report of the committee be accepted and adopted.

Motion seconded and unanimously carried.

Report of Committee on Selection of Time and Place called for.

Mr. Titcomb: The Committee will be glad to hear from any who have suggestions as to places, and inasmuch as we are pretty busy today, it was intended to hold a committee meeting tomorrow on the Fish Hawk which will start at 7:30 a. m. promptly.

Mr. Henry T. Root, of Providence, R. I.: At the meeting at Put-in-Bay last year, after it was decided that this meeting be held at Woods Hole, the delegation from Rhode Island extended an invitation to the Society to partake of a clam bake in Rhode Island waters this year. That invitation was extended in good faith and was accepted at that time, and we expect that everybody that is here, and their friends, will go up there tomorrow on the Fish Hawk, and partake of our clam bake. We have been at the pains of sending up some 10 bushels of our own clams that the Rhode Island Commission has raised, to give you a taste of what we can do in the artificial propagation of clams. And we haven't any doubt at all but that you will have a good time. Crescent Park is a typical resort of Rhode Island, has all the paraphernalia of those shore resorts, and you can put in your time to good advantage. The United States Fish Commission has a very interesting exhibit there too, and we feel that you all ought to come, and we shall be disappointed if you do not. (Applause).

President: It is hardly necessary to put the motion to accept the invitation, as I am sure every one present will go and take his wife and children, if he has them, if it is expected.

Mr. Root: It is expected. You will remember last year that all said they would come and bring their wives, but I do not think that they have done it. If we had known that you were not going to bring your ladies we would have invited some for you. (Applause).

Mr. John B. Whish, Secretary of the Forest Fish and Game Commission of New York State, then read a paper on the subject of "Commercial Values. Some Notes on Studies of the Work of the Forest Fish and Game Commission of New York State," which was discussed.

A paper on the subject of "Fish on the Farm, What Species to Select," by Mr. Samuel Lovejoy, was read by Dr. Bean, and discussed.

The bass question was introduced by Mr. Titcomb, who read a paper by Mr. J. J. Stranahan, which was discussed.

A paper was then read on the subject of the "Propagation of Large-Mouth Bass at San Marcos Station," by John L. Leary, Superintendent, and the paper was discussed.

Adjourned until 2:30 p. m.

At 2:30 p. m., July 22d, 1903, the meeting was called to order by the President at the Boulder in the grounds of the Fish Commission at Woods Hole, and memorial exercises conducted, whereupon the meeting adjourned to meet at 8 p. m. at the office of the United States Fish Commission.

EVENING SESSION, 8:00 O'CLOCK.

Same day, 8 p. m., convention called to order at the office of the Fish Commission by the President.

The Secretary then read a letter from Mr. Henry B. Ward:

Lincoln, Neb., July 17th, 1903.

My Dear Sir:—

Up to the present date I had expected to be at Woods Hole for the meeting of the society, but some personal matters will make it impossible for me to leave here next week. I take the liberty of transmitting the title and will send you the manuscript in time to be read. The paper is entitled "Some Notes on Fish Food in the Lakes of the Sierras." I think that some observations made this spring will prove of considerable interest, in view of the fact that these lakes are without the usual supply of fish food, and yet have successfully maintained trout planted there during recent years.

Regretting my inability to be present, and extending best wishes to yourself and other members of the society, I remain,

Very truly yours, HENRY B. WARD.

Mr. George F. Peabody, Secretary American Fisheries Society, Woods Hole, Mass.

The discussion on bass was then resumed.

A motion was then made by Dr. F. N. Clark, seconded and unanimously carried that the President appoint a committee of three to determine the question of when young bass shall be called fry and when they shall be called fingerling, and frame a definition not only for the United States Fish Commission, but for all the state committees and private hatcheries, the committee, however, which shall be from the American Fisheries Society, not to be confined exclusively to the terms fry and fingerling, but to be authorized to select or invent any suitable term.

The President appointed as such committee Mr. F. N. Clark, Mr. Seymour Bower and Mr. W. DeC. Ravenel.

Mr. M. C. Marsh then read a paper on the subject of "A Fatality Among Fishes in Water Containing an Excess of Dissolved Air," which was discussed.

Mr. Titcomb: As there are only two more papers, Mr. President, I suggest that those be read tomorrow on the boat, and that we now adjourn.

Adjourned to meet on Steamer Fish Hawk next day, Thursday, July 23rd, 7:30 a. m.

Thursday, July 23, 1903.

On board Fish Hawk, July 23rd, 1903, 8 a. m., convention called to order by the President.

Applicants for membership duly elected.

The report of the committee on time and place was then called for.

Mr. Titcomb: The Committee on Time and Place met last evening to hear what any one had to offer for inducements as to the time and place of the next meeting. No one appeared to advocate any place in particular except Dr. Bean and Mr. Clark. Mr. Clark extended the invitation for the city of Buffalo which had been transmitted to him through circulars, as is customary with quite a number of these cities which entertain conventions. Mr. Peabody stated that he had received circulars from several other cities in the same way—Cleveland, Detroit and others. Dr. Bean advocated having the meeting during the exposition at St. Louis, his chief argument being that at that time there will be an international fisheries congress. The committee in taking into consideration Dr. Bean's suggestion, are unanimous in their opinion that during an exposition like the one in St. Louis, the Society would be lost during the meetings in the convention hall.

which would be tendered by the exposition people free. They could carry on their discussions if they would stay there, but it is feared that the members would want to be taking in the exposition. Other than during the actual hours of discussion the members would be scattered all over the city. There is no guarantee of any hotel accommodations—in fact there is practically a guaranty that we could not get them, and we would have to scatter around among the private houses. Now, the social intercourse which we get at these meetings is very valuable. We can hear Mr. Clark begin talking fish at 4 o'clock in the morning and we can hear him at 12 o'clock at night, after we go to bed, and we learn a good deal outside of the reading of papers. I think Dr. Bean's arguments, some of them, are very strong, but the committee believes that these meetings should be held at some point where they can be quiet, out in the country, for instance, or a place like this where there are some particular reasons for assembling, and if possible where they can have access to at least one fish cultural station, to investigate and discuss methods right at the point where the fish are propagated.

In the absence of any other invitation than that from the exposition people, the committee recommend that the matter of time and place of next meeting be left to the incoming President and the Secretary of the Society, to be decided later on.

Motion made and seconded that the report of the committee be accepted and adopted.

Mr. White moved that the matter be referred to the convention to determine as to the time and place of the next meeting.

(Declared out of order by the President).

Dr. Bean: I would like to have the privilege of saying a few words about the proposition to meet at the time of holding the exposition in St. Louis. The invitations which are extended by the President of the Exposition Company, and the mayor, as well as the President of the Board of Trade, give assurance that this Society will be entertained in a hospitable manner, and that there will be no difficulty about accommodations. Those of you who know D. R. Francis will certainly know that he is a man who keeps his word; on that score there need be no reluctance on the part of any member of this Society in going to St. Louis.

I have lived there myself 19 months and I know it is easy to find accommodations within reach of the exposition grounds. Of course the hotel accommodations are scanty, I admit that. I do not live at a hotel now, and one need not confine himself to hotel accommodations in St. Louis. During the dedication ceremonies 100,000 people could have been accommodated in private houses who did not avail themselves of the opportunity and went away disgruntled because they could not get into the hotels. I do not blame the people for not over-building. Chicago and Buffalo had their fingers burned by over-speculation in that direction. St. Louis is conservative, its financial standing is of the highest, and there is no reason why they should build beyond what the natural growth of the city will sustain.

Now, I want to say another word in another direction. The United States Fish Commission is going to have at St. Louis the finest display of fishery and fish culture that it has ever prepared or that the world has ever seen. That is one feature that we will have at St. Louis, and only at St. Louis. We will certainly not have it at Buffalo. The nations of the world are coming to St. Louis and they are coming there bent on acquiring information about the fisheries and fish culture of the United States. Representative men will be there from all over the world. Now, gentlemen, how will it appear if the force and the life of fish culture in the United States, represented by the United States Fish Commission and the American Fisheries Society, should be omitted from that program to which we have invited our foreign representatives? It would be a shame and a disappointment, and I do not believe this society would feel that it had done itself justice. The American Fisheries Society represents today the activity of fish culture interests in our country. The people who are coming are the best that Europe, India, Ceylon, Australia, China and Japan, can produce. France and Germany will be there, also Great Britain, Norway and Sweden. Now, why should the United States be left out as far as its representation by the American Fisheries Society in connection with the United States Fish Commission is concerned? That is about all there is of fish culture. I do not mean, of course, to omit the states, not by any means, but the states, too, will be there, 20 or more of them will be represented in that little building over which I have the pleasure of presiding, and still more of them in other buildings. Now, would it do, do you think it would be altogether creditable to us—we have labored long and earnestly to advance the cause of fish culture—to stop right now and hide our light under a bushel and let the foreigners go away believing that the state of Missouri, for instance, is all that there is of fish culture? You will have there the fish culture station within Forest Park which can be visited; the state of Missouri has a fish car which I have not the slightest doubt will be placed at your service if you wish to go to the Ozark to see how the rainbow trout is thriving, and you can study other fishes to your heart's content. Furthermore, you will gain more members in St. Louis than in any other city of equal size, and I hope this subject will be very fully considered before it is left in uncertainty. (Applause). With due respect to this committee, we have a large gathering of members, larger than we have ever seen at our meetings before, and if it would be in order I would propose that this gathering here vote upon the place where we are to go, and I make that as a motion.

Motion seconded.

President: There is a motion before the house, the adoption of the report of the committee.

Mr. Titcomb: As chairman of the committee perhaps I ought to explain still further the consideration given to Dr. Bean's argument. It is true that there will be an international fisheries congress, and we understand that there will be representatives from all over the world of the fishery interests, and the states will undoubtedly have delegations to attend this international fisheries congress. The United States Fish Commission ordinarily sends representatives also to the International Fisheries Congress; in Paris it had two representatives.

Now, the Fisheries Society would meet, of course, as a society. This society would not run the International Fisheries Congress. It is the privilege of every member of this Society to attend that congress, and of course if the meetings were held there and held on separate days so that it would be possible to do so, the members would have a chance to talk fish a week instead of three days. But I cannot see just how the Society as a society can hold its convention in connection with the International Fisheries Congress on the same date and in the same meeting without losing its identity.

President: Have the time and place of holding the National Fisheries Congress been fixed?

Mr. Titcomb: I understand not.

Dr. Bean: I believe not.

Mr. Titcomb: Then how can we determine the date of our meeting.

Dr. Bean: The exposition has furnished one of its finest buildings, the new library building of the University, which is divided up into session rooms, capable of holding all the congresses that may be there in any one day, and there is no reason on earth why the Fisheries Society should be lost—in fact, it could not be lost—it could not lose itself if it tried. Imagine the Fisheries Society lost. We have heard of a lost salmon or a lost carp, but never of a lost fisheries society, and I hope we never will. (Applause).

Mr. Atkins: Allow me to say that it seems to me decidedly better that we should not undertake at this meeting to determine when or where we shall hold our next meeting. I think the proposition of the committee to leave that to be determined by the officers later, is a very wise one, and that we had better not undertake here to fix the matter, because I at least on my part do not feel sufficiently informed in relation to it as to what the facilities will be at St. Louis and other places.

Dr. Bean: I understand that the incoming president has a choice.

Mr. Clark: No, I want to correct that, not that I care to have this left to the committee, but I wish to correct the doctor right here. I have no choice, and so stated last evening before the committee, and I think the doctor will bear me out, that personally I have no choice, I was simply doing that which I thought was my duty as a courtesy to a city that is entertaining many conventions, the same as my own city of Detroit. The secretary of the convention association of Buffalo, composed of the city officials of Buffalo and many others (very fine gentlemen), corresponded with me and urged that I take the matter up. I had a great deal of correspondence with them and tried my best to have a member of that committee here, and after all the correspondence and considering to a certain extent my position in the American Fisheries Society as being one of the old members, I felt it was due to that city and committee that I should present the name, but I took special pains last evening to say it was not my personal choice. Am I not right?

Dr. Bean: Yes.

Mr. Titcomb: For the committee I wish to say that they have some of the same reasons for recommending that we do not meet at Buffalo which they have for recommending that we do not meet in St. Louis. Buffalo would be a more comfortable city in July than St. Louis. St. Louis will be very hot, probably, but the committee believe that this Society should meet in some quiet place, where there are no distractions whatever, where we can have our meetings by ourselves and enjoy the country air and all that sort of thing, and if possible get at some fish cultural station, or go to some point centrally located where it will be possible for us to take in the St. Louis exposition on the way.

Mr. Clark: Just one word more, if you will permit. The members may think I want this thing left to the officers, but I do not. The only reason I have not positively refused to allow it to go that way is, that so long as I have been an active member in the Fisheries Society, some twenty-seven or twenty-eight years, I do not think I can call to mind a time when the recommendations of the committee on time and place or officers were turned down.

Mr. Atkins: I move that the committee be instructed to investigate this matter further and to report to the officers of the Society at a later date in relation to the subject of the time and place of the next meeting.

Dr. Bean: I would like an expression of opinion from the members of this Society. I think we should accept or reject the invitation of St. Louis. I have been sent here for the express purpose of inviting the Society to meet at the exposition, and they have given every assurance that the Society will be welcomed and well cared for, and I think that it is due to the exposition that we have an expression of opinion of the membership present, and I would like to have it very much.

Secretary: I would like to say a word regarding the invitation from the exposition and the mayor of the city, etc. Dr. Bean is undoubtedly sincere and earnest, we all know that, and these men who give this invitation are undoubtedly for the moment sincere and earnest, but they are going to be swallowed up in thousands of invitations and of much larger societies than this, and when we get there we simply would not be noticed. Now, in Milwaukee—General Bryant will bear me out in that—we had the mayor of the city, commercial societies and others send us invitations and saying that they would make it pleasant for us, yet we hardly saw anybody in Milwaukee—not that it is necessary that we should be entertained, but yet it is something to be in a place not so large but that we will be recognized in a way.

Now, as to the accommodations at St. Louis in July. If we are going to St. Louis we certainly should not go there in July, because it is a very hot place, and not only that, but the city will be thronged with people, and Mr. Titcomb's point I think is very well taken, that we ought to be in a place where we can meet together after the meetings to interchange thoughts and social amenities, which we cannot do in a large city. We will have to be scattered around at private houses and all that sort of thing, and only meet at our regular sessions, and I fear very much that the attractions for some of our friends here will be so great that we may not be able to discover them at the meetings—I do not know but what I would get lost myself in that case. (Laughter). Now, it seems to me that we ought to consider some quiet place. I have had invitations as secretary from Cleveland, Detroit, Niagara Falls and half a dozen of those places, which I have not presented to the convention, because they are conventional invitations and these are convention cities, and it is a professional thing for them to attempt to get conventions there to help out their hotels and one thing and another, and for that reason, while I do not wish to have anything to do in deciding this question, I do think it ought to be very carefully investigated, and it seems to me the success of our meetings depends very largely upon the location and the time, and we have, after very careful investigation decided upon this time of year for meeting. It seems to be an opportune time. Now, men who are interested in schools and colleges, professors of biology, etc., such as General Bryant, for example, have this time of year as their vacation period when they can come here, and I think it meets the convenience of more men than any other season of the year. I, therefore, think St. Louis should hardly be considered on that account, and yet if it is the voice of the convention we will do all we can to make the meeting a success.

General Bryant: I feel like supporting the motion, leaving this to the officers to settle. It seems to be very generally understood that it would not be comfortable for us to go to St. Louis in July. I spent a summer in St. Louis many years ago, and I think you can find grease spots on the pavements yet where I larded the lean earth (Laughter), and if you put it off until September I cannot go. I have to go on the jail limits in Madison at that time, for I am a professor at the University. I want to come to these meetings. It has got to be part of my living to attend the meetings of this Society. If you have them at St. Louis I must be left out. Then, too, if you go to St. Louis you would have to put a ball and chain on Brother Lydell to keep him anywhere within reach. (Applause and laughter). I appreciate Dr. Bean's position entirely and I sympathize with him, and I think I could risk a day or two at the International Congress, but if I go there I want to go there as a delegate, representative, or humble member to sit in that congress, not with a divided duty, a split affection, and I do feel that we enjoy ourselves better, we get into closer touch, than we would with all our young lads running off for a Midway Plaisance (Laughter); and that is my feeling about it, partly selfish and partly for the interests of the Society. Now, if developments are such that our officers shall think at a later day that that is a proper thing to do, why, we will all acquiesce in it. If they select some other locality I have no doubt they will select one that will be very congenial to us all, and for my single and humble self I should prefer to leave it in that way. I hate awfully to disappoint Dr. Bean, but I am afraid if we get down there in that great multitude we would feel like a small boy at a circus.

Dr. Bean: It is not a question of disappointing Dr. Bean or Doctor anybody, it is a question whether the American Fisheries Society is big enough and strong enough to take its place as a man in fishery matters. The other people are coming there, are we going to stay away? Now, I really would like to have an expression of opinion from the members here, and I wish that Mr. White's motion would be entertained.

President: In the absence of a substitute being offered, there is only one question to be considered, whether or not the report shall be accepted or rejected, and the question is on the committee's report.

The motion to adopt the committee's report was then unanimously carried.

Dr. Bean: This is to be left with two officers, the President and Secretary?

President: Yes, and St. Louis may stand a pretty good chance yet.

Dr. Bean: If a vice-president were included possibly the leaven would work. (Laughter).

Mr. Clark: With the consent of the committee and the members of this association I would like to make a motion that the Vice-President, Dr. Bean, be added to that committee.

Motion seconded and unanimously carried.

Mr. Clark: I want to say that I feel if I am not broad enough, our secretary and Dr. Bean are able to take up this question and settle it for the best interests of the society, even if Dr. Bean is strongly committed to St. Louis, I feel that between us we can convince Dr. Bean to the contrary, if it is thought best to go to some other point, and I know that he is broad enough to accept the situation.

President: Doctor, you are in it. (Great laughter and applause).

The auditing committee then presented its report, that the committee had examined the report of the treasurer and found the same to be correct.

Report accepted and adopted.

Mr. W. T. Thompson then read a paper on "The Golden Trout," which was discussed.

The President then read a paper by Mr. Henry D. Ward on the subject of "Some Notes on Fish Food in the Lakes of the Sierras."

Mr. Clark: I would like to express my appreciation to the members of the American Fisheries Society in honoring me by an election to the presidency, and I want to say, gentlemen, that I feel highly honored, I only fear that I have not the ability to preside in an acceptable manner so that I may come near the degree of success of my predecessors. I do not wish to take this honor thinking that the members of the American Fisheries Society have honored me alone. It is not so. They have shown their appreciation by honoring the practical superintendents of the United States—that is what they have done. It is not Frank Clark alone, but it is the superintendents of the United States.

Now, members of the American Fisheries Society, I may not have an opportunity of shaking hands with all of you before I leave you, but I want to say again in thanking you for this honor for myself and the practical fish culturists throughout the United States, superintendents and others, I want to say to you one and all, good-bye till we meet again next year at ————. (Laughter and applause).

President: I wish personally to congratulate you on the success of your meeting. I am sure that good results attained here will inure to the benefit of the fisheries of the United States, and you deserve the good will and the congratulations of every man interested in fisheries. (Applause).

Secretary: I desire to offer the following resolution:

Resolved, That the Society extends its hearty thanks to the United States Fish Commission, to Mr. Locke of the Woods Hole station, and to all others who have assisted in entertaining the Society at its present meeting, for their many courtesies and thoughtful attention, which have done so much toward making this meeting one of the most delightful in the history of the Society.

Motion seconded and unanimously carried.

Mr. Clark: I move that the thanks of this Society be extended to the officers for the last year, for their good hard work in providing for this Society, and for the presiding and other work that they have done at this meeting.

Mr. Blatchford put the motion.

Mr. Blatchford: All those in favor of that motion thanking these faithful and honest men (I think they are honest, the Auditing Committee says so), will say aye.

Unanimously carried.

Mr. Blatchford: If there is any chap questions it let him say, nay. (Applause and laughter).

Adjourned.

AFTERNOON SESSION, 2:00 O'CLOCK.

At 2 p. m. the steamer reached Crescent Park, near Providence, where the Rhode Island Fish Commission spread a magnificent clam bake banquet in honor of the society. The governor of Rhode Island, his staff and many prominent officials of the state and citizens of Providence were present, and the society was welcomed by the governor, who said:

In behalf of the state of Rhode Island I welcome the American Fisheries Society of the United States.

At the conclusion of the banquet Mr. Root said:

It is a well known fact to you all that the United States stands at the head of the fisheries of the world. Now, I wish to impress upon you that a condition of that kind must require great executive ability, organization and energy, that can be found in scarcely any other occupation, and I further wish to state that we have with us today the most noted men in the fisheries industry of the world. (Applause). Now, we have such men here as you have all read about, such as Livingston Stone; we have all read about Dr. Henshall and his bass rods and reels; we all know Dr. Atkins and Dr. Bean, the great expert on fish anatomy. Now, to handle all this thing and get the position that the United States has got, as I said before, requires great executive ability, and a head must be wonderful that can handle all this. We have today here twenty-one superintendents of the hatcheries of the United States. I venture to say such a number never got together before. Now, what I got up here to say was simply to introduce to you the head of this great organization the Hon. George M. Bowers, of Washington, D. C., Commissioner of Fisheries of the United States. (Great applause).

Mr. Bowers: Governor Garvin, Ladies and Gentlemen. Owing to the lateness of the hour and the fact that quite a number of the members of my party are expected to return to Woods Hole between the hours of half past four and five, I shall not make any extended remarks. I congratulate you, Governor, on the efficient, able representatives you have composing the membership of the Rhode Island State Commission. I congratulate the state of Rhode Island upon the prominent position it has attained in fisheries, and I have before in conjunction with the members of the American Fisheries Society, accepted the hospitality of your people, which we all appreciate, and I hope the day is not far distant when one of our meetings may be held in your state. (Applause).

Mr. Root: I wish to further state that the American Fisheries Society is thoroughly a United States organization, and has got to have a head also. Commissioner Bowers is above all of them, but we have a president of the American Fisheries Society, a man that when he gets talking about fish will talk from 4 o'clock in the morning till 11 o'clock at night—he cannot talk on any other subject, but I want him to stand up so that you can see him—Mr. Frank M. Clark of the Michigan State Association. (Great applause).

Mr. Clark: I think I voice the sentiment of the American Fisheries Society when your Governor of Rhode Island welcomes them to this clam bake, in saying that they heartily thank you for this entertainment. The American Fisheries Society extends over the whole United States, and this little state of Rhode Island is entertaining us in this generous manner. I have attended the American Fisheries Society meetings for many years, and I have attended two entertainments given by the Rhode Island people, and I assure you that I voice the sentiment of the American Fisheries Society when I say that we have never in this broad United States received such entertainment as we have received in the state of Rhode Island. (Applause). I wish to say, Mr. Toastmaster, that the American Fisheries Society and all of its members again thank you for this very generous entertainment. (Applause).

Mr. Root: Right here I wish to say that I think the state of Rhode Island never profited more by any delegation that visited its shore and partook of its clam bakes than it has from the people we have here representing the American Fisheries Society. I believe that if you could attend one of their meetings and hear their discussions of papers, you would agree with me heartily, and we consider it a great honor, Mr. President, of the American Fisheries Society, that you have accepted our invitation to come here.

Secretary: In behalf of the American Fisheries Society I wish to offer the folowing resolution:

Resolved, That the Society offer its grateful acknowledge for the courtesies extended by the state of Rhode Island Fish Commission, for its generous hospitality that rounds up in a most appetizing way one of the most, if not the most, successful meeting ever held by the American Fisheries Society.

Motion seconded.

Secretary: Before that resolution is put I would like to say: One year ago Mr. Root, President of the Rhode Island Commission, told me a fish story at our meeting at Put-In-Bay. He said that one morning at a lake near by where he has a summer home and lives, he caught sixty-eight bass that weighed 13 pounds apiece, all wall-eyed black bass. I do not know that this is accurate, because we have just enjoyed a large dinner, but it is as near as I can get to it. Now, I repeated this story to a friend in Chicago, and he said, "A lake in Rhode Island—there are no lakes in Rhode Island—it is not big enough for a lake." I wish I had that gentleman here now. He would think Rhode Island was as big as the state of Texas. (Great laughter and applause).

General Bryant: I rise to support this resolution. A political friend of mine once said when he had felt the ingratitude of men he had helped and favored in politics, and I was trying to console him, with a rueful shake of his head, "Hungry men are never grateful for last year's dinners." (Laughter). I want to say that that is not the principle nor the characteristic of the American Fisheries Society. We came here three years ago at the invitation of your good people, and we had one of your clam bakes, a feast so unique, so excellent, so noble, that it has lingered in our memories for three years, and there is not a member of this society that has not turned his thoughts towards Rhode Island, with a grateful emotion, ever since, (great applause) and today that has been repeated, with added charms, with added excellence, and upon us is heaped an added weight of gratitude which will be carried all our years.

There is something about these Rhode Island clams that is very remarkable, and it has opened my mind and let into it a great flood of light. After we had dined here three years ago and partaken of this nourishing food, there was not a member of our society that did not feel such an expansion of his mental power and his self-confidence, that he looked upon himself as capable of being the governor of a state, member of congress and chairman of a leading committee, or even a senator in the senate of the United States (great applause and laughter) and after having taken a second feast in this beautiful spot, I am free to say that I feel perfectly competent now to be President of the United States (great applause), and if you would only give me a congress agreeable to my way of thinking I give bond that I would revise the tariff, smash the trusts, regulate labor and capital, and put them on a harmonious basis and save the government in the expense of administration two hundred and fifty million of dollars, and at the same time we would double the appropriation of the Fish Commission (great applause and laughter), and give a special bonus to every state fish commission in the United States. (Great laughter). All of that we could do if you fed us on clams. (Great laughter and applause). We lawyers read in the lighter literature of our profession, that a man could get admitted to the bar in England if he entered the inns of court and ate so many dinners at the hostelry of the inn—I think about two dinners here would be equal to a good college education. (Great laughter and applause).

But pleasantry aside, your Excellency and Gentlemen of the Rhode Island Fish Commission, again in the name of the American Fisheries Society I want to extend to you our heartiest thanks for this magnificent banquet you have given us, on this beautiful spot, so lovely that we are loath to leave it, and to leave you, and as we go away I want to voice the prayer of this society, in praying that the good fish commission of the state of Rhode Island may long be detained from that mansion of rest provided for the American Fisheries Society in the realms of glory. (Great laughter and applause). I hope they may long be detained from it to be benefactors of mankind in this beautiful state.

And I have another prayer to the executives of this state, who may come and go—politics change—I want them to keep those magnificent old spirits, Commissioner Root, Commissioner Willard, Commissioner Boardman and the others I will not name, in the posts of duty where they are accomplishing so much good. (Applause).

Now, gentlemen, the Amercan Fisheries Society are a very good people. Modesty forbids us telling how good we are, but honesty compels us to admit it. (Laughter). This world is made up of very bad people, bad people, good people, very good people, extraordinarily good people and the American Fisheries Society. (Great laughter and applause). Now, that may seem a hard saying, it may seem boastful, but I call on you to remember that when our blessed Savior came on earth, one of the miracles that he performed to testify his great power, the omnipotence delegated to him, was to multiply the fishes in the sea. That miracle, I say reverentially, Your Excellency, through the aids of science, through the work of these noble men who constitute the working force of this great society, we are accomplishing today. There is hardly a river in our myriads of streams, there is not a coast on our illimitable line, that is not blessed and multiplied by the work of the United States Fish Commission, the State Commissions, the American Fisheries Society throwing in its moral force, its investigation, its uniting of all the men engaged in this great work. They are not working for fame, nor for fortune. They are working for the public good, and years hence along this shore of your beautiful bay, men will rise up to call blessed the commissioners of fisheries who during their brief span of life have labored faithfully without fee, without salary, without compensation other than that chiefest of all compensations, the consciousness of a good duty well performed. (Applause).

And, gentlemen, again one and all, you people of Rhode Island, we shall carry to our distant homes the pleasantest remembrance of your kind welcome and the charming feast you spread for us today when we came among you with appetites saved up to enjoy it. Good-bye! (Great applause).

President Clark: You have heard the resolution as offered and supported by General Bryant in such an excellent manner.

The motion was then put and unanimously carried.

Secretary Peabody: I have another resolution to offer:

Resolved, That the American Fisheries Society gratefully acknowledge the efforts of the Commissioner, Hon. George M. Bowers, in making the meeting of this society a success, and also acknowledge the courtesy and efforts in making the trip from Woods Hole to this point a delightful one on the part of the officers of the United States Fish Commission steamer Fish Hawk.

Mr. Blatchford: I rise without taking any time to make any remarks which I would like to do, very heartily to second that resolution. (Applause).

Unanimously carried.

Adjourned sine die.

Deceased Members since last meeting:

Dr. E. Bradley.

Gen. E. E. Bryant.

Dr. Bushrod W. James.

S. L. Griffith.

PART II.

SCIENTIFIC PROCEEDINGS.

ANGLING FOR CARP, AND SOME HINTS AS TO BEST MODE OF COOKING.

BY S. P. BARTLETT.

In compliance with a request of the Corresponding Secretary, I have the honor of offering a few suggestions as to the catching of carp with hook and line, and some of the popular ways for preparing them for the table.

The question has been asked me a great many times why it was that carp cannot be taken with the hook and line. A great many persons have told me that they have used all kinds of bait and failed to get them to take it. These inquiries came to me as a surprise from the fact that hundreds daily fish for carp with hook and line on Quincy Bay and all along the Illinois river with great success.

I have found the best bait to be a dough ball made by boiling cornmeal to a good stiff mush, and then work the ordinary cotton batting into it until it becomes hard and stiff, and then rolling into little round pellets about the size of a marble. Bait prepared in this way will not be easily dissolved by the water. I use the ordinary Carlisle hook fastened on the end of a good strong line and three or four inches above the hook, attach quite a heavy sinker which will take the line to the bottom and allow the bait to flow up away from the bottom. Another good bait is the ordianry ship stuff from the mills, boiled stiff and dough rolled out in sheets, and then cut up into little spuares, perhaps three-fourths of an inch square. Fried potatoes, sliced raw and fried until they become stiff, not brittle, also is a fine bait. Anyone conversant with the hook and line at all, will have no trouble in catching carp if this bait is used as indicated.

On Quincy Bay, I have seen as many as two hundred people fishing for carp along the shores, and nearly all of them get good fair strings. The carp when hooked is a very vigorous fighter, and care must be used that he does not break the hook or break out the hook from his mouth. I would advise the use of the landing net. They are daily taken on trout lines, using the same kind of bait.

Since your request for information as to the carp from an angling standpoint, I have given the matter a great deal of attention, and have been greatly surprised at the extent to which carp are caught with hook and line. From Cairo to Dubuque on the Mississippi river I have found shores at all the towns lined with people fishing for carp, all catching them. One day last week, from the lower end of Peoria, Illinois river, to water works point, a distance of three miles, I counted 1,103 people fishing with hook and line, and on investigation developed that a large per cent of them were taking carp. The majority of those caught weighing a pound and as heavy as five pounds, all of them probably used as food.

Permit me to introduce here a letter from one of the best known sportsmen in the state:

Peoria, Ill., June 23, 1903.

Hon. S. P. Bartlett, Esq.,
Superintendent Fish Commission, Quincy, Ill.

Dear Sir:—

Carp fishing with hook and line has now taken its place with bass and other kinds of fishing. All along the river in this locality carp are being caught freely with hook and line this year, and to say they are gamey, is not half expressing it. For the past month, I have made it my business to go along the river and take notes of this particular kind of fishing and talked with no less than 25 different persons who were busy catching carp, and in every instance I was told it was rare sport to hook a carp, as it was quite as much of a trick to land one as it was to land a bass; dip nets were used generally to land the carp, as the activity of the fish when jerked out of the water would tear the gills and free the fish quite often. The bait used when fishing for carp is dough balls and partly boiled potatoes, the latter being best in the opinion of the majority. The carp will bite on worms quite freely also, and in two instances, I found carp had been taken with minnows, something that has been considered impossible heretofore, but in these two cases I am certain it was done, as I have the names of the parties who caught the fish. An old German who lives here goes daily to the river with a regular fly casting pole and reel to fish for carp, of course, he exchanges the fly for the regulation hook, but he used his reel in landing the carp, and says there is no finer sport than fishing for carp. This man uses partly boiled potatoes altogether and is very succesful in taking carp in numbers daily. I have caught a great many carp myself with hook and line, using potatoes, dough balls and worms, and found that the partly boiled potatoes worked best, as the carp seemed to take that particular bait when they would not bite on any other. As for the sport of catching carp with hook and line, I consider it equal to anything in the way of pleasure fishing, as the fish is gamey and will fight as hard against being landed as bass or other game fish and are to be handled with precaution on account of their tender gills, which will often tear when hooked by an inexperienced angler. In the past two years carp have become popular where they were unpopular, because of the wearing away of the prejudice that they were of no benefit to the angler on account of the belief that they would not take a hook. Now it is different, as the very ones who were so loud in their protest against the carp, have found great sport in taking them with hook and line, and it is wonderful to hear the change of sentiment as to the carp for food purposes. They are a good fish now and fit for a king in comparison to what was said of them while the prejudice still existed. To my mind the carp is a good fish for food purposes and is fast finding favor in the west in every way, now that the angler has found it is the coming fish for sport. Just at present in the Illinois river, we have a world of all kinds of game fish and no end of carp, which insures the angler his full measure of sport until the end of time.

Most respectfully yours,

M. D. HURLEY, Peoria, Ill.

NOW HOW TO COOK THEM.

I feel sure that most of the prejudice to the carp as a table fish is from the fact that they are too often taken from the warm water, fried and broiled without preparation. Their rapid growth and the warm water they are taken from, has a tendency to make them soft. I have found the best mode of preparing them as follows: Kill as soon as caught, by bleeding, taking out all of the blood. Skin, soak in salt water for several hours, then parboil and bake, basting frequently. They are frequently served here as a boiled fish, covered with proper dressing. It takes but a slight stretch of the imagination to place on bill of fare as anything from blue fish to buffalo. Today I had blue fish served with my soup at one of the principal hotels and it would have passed as such with the average man, tell-tale bones, however, said carp.

I give herewith a receipt of Swedish origin, given me by Dr. Weiss of Ottawa, Ill., President of the Fox River Fish and Game Association, who assures me that the perfected product is equal to the imported fish jelly that brings $1.00 per pound.

CARP OMELET OR CARP JELLY. (Swedish).

"Take a six to eight pound carp; scale and skin. Leave head and skin. Cut into small pieces and place in boiling water just sufficient to cover and add salt, coarsely ground pepper, allspice and a bay leaf or two. Boil about twenty minutes or until perfectly soft. Remove from the fire, remove pieces of fish from the water, but preserve the water. Break the pieces so as to be able to remove all of the bones thoroughly. Skin fins and head pieces. Strain liquid through a colander and if necessary add a cupful of gelatine, previously dissolved, to this liquid. At the same time add such other spices as may be desired. Add the original pieces of fish to the liquid or gelatinized liquid. Stir and place on ice until solidified."

I was greatly surprised at a statement made by Mr. Cohen, president of the Illinois State Fish Commission, to the effect that he had seen carp on menu of Waldorf Astoria hotel, New York, and at a price per portion higher than fresh mackerel. I was inclined to think he was telling me a fish story. In order to verify, he wrote chef of that hotel and received a letter and copy of bill of fare, which absolutely confirmed his statement.

In concluding this brief paper, I wish to say in explanation that in some way I have been considered special champion of the carp, and as such have been frequently misquoted.

I do not wish to be understood as saying that the carp compare favorably with our whitefish, bass or other game fish, salt or fresh. I want simply to repeat former statement, i. e., that the carp have in our western waters, filled a need, that nothing else would or could do. They have taken the place of the buffalo, now so rapidly decreased, and that they furnish good wholesome food to thousands who could not afford to use the more expensive fish, and who in a great measure depend on cheap fish for meat, that they have and are paying thousands of dollars to thousands of men in taking them for market, that they furnish equal sport for the angler with game fish, and as a combination are yet to have a place with other fishes, no one can doubt, and coming, come to stay.

DISCUSSION OF MR. BARTLETT'S PAPER.

Secretary: I want to say before reading this paper that the papers and discussions on carp of this Society have excited widespread interest, and as Secretary I have received innumerable letters on the subject, some damning carp not with faint praise, but most eloquently, and a few that favor the cultivation of carp.

Mr. Titcomb: A good many.

Secretary: Yes.

Mr. Clark: I have no doubt the members would like to hear from Mr. Ravenel on the carp question.

Mr. W. De C. Ravenel of the United States Fish Commission, D. C.: I have nothing to say. I endorse the paper.

Secretary: I would like to hear Mr. E. W. Blatchford's opinion regarding carp—he has eaten them.

Mr. Blatchford, of Chicago: Mr. President: I think it is twenty-eight years this summer since my first trip abroad; and I took a leisurely trip on the Rhine and was served with a fish for breakfast, I could not make out what it was. The waiter was a German, and he gave me the German name for this fish. My daughter, who was with me, spoke German fluently, and recognized the fish as a carp. I was much interested in it. I had heard about the carp, had read about it, but had never seen one until then. I asked our landlord if he would get me some; I wanted to see them; and he said, yes, that he would show me some that afternoon, and I went down and saw them swimming about in an enclosure. He said he had three ways of cooking them, and one of them was very much like the description given by my friend Bartlett, of Quincy; but they were a delicious fish, and I came home and began to speak about carp; but I have met few men or women here that did not turn up their noses at a carp. But the carp have been developed by being placed in waters adapted to them. I believe you can find plenty of streams in this state, and New York, and in the west, that would not be fitted for carp; but I have lived in Quincy, my parents lived there, and I know something about the interest that is taken in fish there on the Mississippi river; and have heard of them in Illinois, but I have never heard such an excellent statement as that made by the gentleman from Peoria today. I am very glad of it. I do not know of any man that I sympathized with more, than with our honored secretary in the paper that he presented. I do not know whether he sent me a copy of the paper which I received—perhaps he is too modest to do it. He wrote a letter to a Wisconsin paper, a column and a quarter long, and put the carp right where it ought to be placed. I am not prepared to make any extended remarks, but want to say just one more thing: I enjoy these meetings and I regret that I could not be at the meeting in Put-in-Bay or Milwaukee, because both those years I was in England; but the last meeting I was at was held here—and why are these meetings interesting to me, and why ought they to be interesting to a great many more people than attend them? (And it is our duty to let their value be known and get them to attend them). The reason is this: We are working for a thing that has a clear and distinct element of utility *to our whole country.* Now just take the facts presented here by Mr. Peabody today, the number of people that are employed in this business, and the excellent food which they are securing by it: I think that is a very valuable paper that Mr. Bartlett has written. I do not know whether you all know him or not. He is our state commissioner of fisheries in Illinois, and he is a thorough student of whatever he takes hold of, and I do not know of anyone whose words are more valuable than Mr. Bartlett's. Is not that your experience with him Mr. Secretary?

Secretary: Yes, sir.

Mr. Blatchford: I feel that we should be thankful to have such a paper as that brought before us. (Applause).

Mr. John D. Whish, of Albany: Speaking of the experience we have had with carp in New York state, I should say we were getting considerable information right here. In our state the fish is regarded as a pig. The line fishermen do not like him. and the net fishermen curse his existence. We are today conducting experiments in various parts of the state, to find out whether it is true or not that the carp in New York state destroy game fish. The fishermen say that he does, and we have any number of letters on file in the office of the Commission, complaining about it; there is not a day that passes but we get an application for permission to net him out of some water; but that is an impossibility, because he is like the English sparrow, here to stay. The fact however remains that our people are prejudiced against the carp as a fish and want to get rid of him. The county authorities of Erie county, two months ago, applied for permission to net the carp out of the Niagara river. Of course, anybody who knows anything about that river, knows he could not be netted out of there in a million years, if he was in there at all. But they got the permission and took out carp by the wagon load. The fish were disposed of to Italians and Poles at a low rate; and they seem to be the only nationalities who can cook the carp fit to eat. We are beginning to go a little slow with these permits to net out carp however, for the reason that the sentiment is veering around somewhat in its favor—that much I am willing to admit; but further than that, it is doubtful to my mind whether we will ever have a very great carp market in the Empire state.

Secretary: I would like to ask if the gentleman knows what the market price is or has been during the past year in New York city, at wholesale?

Mr. Whish: I do not know.

Secretary: I read the quotations every week in the Fishing Gazette. During the cold months it varied from 9 to 10 cents a pound at wholesale, and compared well in value with other first class fish.

Mr. Whish: The complaints we received are from the inland counties.

Mr. R. Tyson White: Many fishermen along the lower part of Long Island and South Bay are making a living from carp, selling them as fast as they catch them.

Mr. Clark: I do not wish to say very much on the carp question, but the question of carp interfering with anglers and the destruction of bass has been pretty thoroughly exploded by some member of the United States Fish Commission Scientific corps —I do not know who it was, that made some investigations in Lake St. Clair; and I think if the people will take pains to read what has been said in regard to that, they will find his conclusions were that carp did not interfere with bass or perch. I do not think the carp interferes in any manner with the eggs of these fish. The only complaint that I hear from up around the

Great Lakes, is from the duck hunters. They claim that the carp are destroying the rice roots, and possibly you may find that difficulty.

Secretary: It is so claimed.

Mr. Clark: I think the carp has come to stay in the Great Lakes as a commercial fish, and I do not think they are hurting the other fishes at all. We know in Michigan they are catching them in Monroe and Maumee Bay, by the tons, and in the month of June, while they were catching them, the Fishing Gazette quoted them at 4 and 5 cents a pound wholesale.

Mr. J. L. Leary, San Marcos, Texas: As to his destroying the eggs or young fish, it is not a fact. My experience is that I could not raise the crappy in clear water, and I adopted the plan of putting so many carp in crappy ponds, and I raised some crappy and no carp, showing that the young carp are all destroyed by the crappy. The smallest sun fish can chase him away, for the carp is a big coward; the carp is a rapid grower and a good food fish. I have young mirror carp hatched last March, a year ago, that today weigh 4 pounds. I have nothing but mirror carp. I have kept up with the quoted prices; I never pick up a paper that quotes the fish price in any market. but what I look at carp and always find him selling at a good fair price; and in winter time he sells for possibly twice as much as during the spring. I am a North Carolina fisherman, and in fishing I caught carp in the sounds, and early in March I have realized as much as 20 cents a pound for them in the New York market—of course we did not catch many. I do not say they are as good as Spanish mackerel, but they are good, nevertheless.

Mr. W. De C. Ravenel: How large ponds did you raise crappy in?

Mr. Leary: A quarter of an acre. I have three ponds at San Marcos, Texas, of three-quarters of an acre each. The other fish destroy carp, but the carp do not destroy the other fish. Take the San Marcos river for instance: I know lots of our young carp escape during the floods, and several of the old carp, my brood fish, were caught with dough balls in the river, this spring. I believe he is a good and valuable fish and growing to be more popular all the time. He is certainly an economical fellow, because he grows fast, and will furnish a large amount of food in a short time.

Mr. Charles G. Atkins, of East Orland, Me.: Can any of the gentlemen speak of the climatic influence on the growth of carp; for instance, if there is a northern limit where they cannot spread on account of cold? I am from Maine and I am not aware that they have established themselves at any point, and I wonder if it is because the climate is unsuited to them. We have tried to plant them in Maine, but have not succeeded as yet. Is the climate there too severe, and does anyone know how it is in Michigan or northern New York, for instance?

Secretary: Carp thrive in Wisconsin, which has about the same climate as Maine; we have the temperature as low as 30 below zero; and I know that in a certain marsh preserve where it is water and mud, and it freezes, as we fancy, solid in winter, and freezes all the other kinds of fish out, they thrive beautifully, and I believe they are pretty near frozen stiff—there cannot be any water left in there which is not frozen, and yet the carp thrive.

Mr. Atkins: I have an idea that they are found in Norway and Sweden, and if that is the fact they ought to thrive in Maine.

Mr. Titcomb: They exist in Vermont in two or three ponds; but they are not of any value there, because we have other fish which are more desirable, and people do not know how to catch them. I do not think carp will obtain as large a growth in a northern climate as in warmer waters; and in clear waters I do not think you need fear any bad influence from their introduction. I do not mean that I am opposed to carp in proper waters for them; I think that all the trouble that has arisen about the carp has come from the indiscriminate distribution which was made when they were first brought to this country; and today, if properly distributed, they would do a great deal of good. The United States Fish Commission is receiving daily applications for carp, mostly from the western states, Kansas, Nebraska, and out in that vicinity, where they have a great many warm water ponds; and I have no doubt in some of those places where from the description of the waters it is difficult to name any other fish suitable for them, that the carp is about the only fish they can raise in them.

Mr. Whish: Perhaps I can supplement what I have already said, by the suggestion, that in New York state the line fishermen do not like the carp. I might also note the fact that in the three years during which I have been connected with the Commission, there has not been a single application from anybody for carp, and we do not raise them any longer in any of the hatcheries.

Mr. Tarleton H. Bean, of St. Louis: I would like to say a few words about this celebrated introduction of carp throughout the United States. I have always been a champion of the carp, but speaking now as a newspaper critic of the fish, I object to it for a good many reasons.

In the first place it either has great big scales, or it has no scales at all, and it is not in good taste for it to parade around in that slipshod sort of way, neither one thing nor the other.

Another very strong objection to it (speaking now as a newspaper man) is, that it has no teeth in its mouth, but carries them like a comb, in its throat.

My friend Bartlett from Illinois has given you still another serious objection to it, and that is, that it takes the dough, and we need that in our business, especially we newspaper men. (Great laughter and applause).

But worst of all is a report sent to us by wire from Reading the other day, and that is this: A couple of Philadelphia girls were out fishing on a pond near Reading and they hooked something (as the girls generally do, you know, when they go fishing, (laughter); the first thing they knew they were in the water, and of course several gentlemen rushed to the rescue and got them out, and what do you suppose it was, Mr. Chairman—it was a great big carp! (Laughter). Now when a carp comes to taking away Philadelphia girls, and when it gets to be a question between Philadelphia ladies and the carp, I think that the carp had better go! (Great laughter and applause).

Speaking as a newspaper man, I have several other objections to urge against the carp, but I must save them up. He has been in this country so long he has got stuck up, feels important and big; he has a whole lot of eggs, his family are very numerous, he grows very fast, and people like to eat him, and I am afraid he will drive the cod out of the market, and what will we do without cod? Now I think the carp had better go down, down into the water and stay there. (Great laughter and applause).

Mr. Seymour Bower: One of the objections made to the carp is because he has got scales, but I think there is a way to get around that—at least I heard of an experiment in that direction. An old friend of mine, living on the banks of the Raisin, was in the poultry business, and with rather indifferent success, and he conceived the idea of raising carp in connection with poultry. So he built a few ponds and diverted a stream from the river to the ponds and got in a stock of carp. His scheme was that when he dressed his carp he would feed the offal to the chickens, and when he dressed his chickens he would feed the offal to the carp; (laughter) and of course, each would sustain the other. It was to be a sort of an endless chain arrangement, a kind of reciprocity scheme that promised big dividends. I saw John a few years after that and I said: "John, how did your combination hen-carp enterprise come out?" And he said, "it didn't turn out just as I expected; it worked first rate for a while, and I thought I had a fortune, and I would have had too, but those confounded chickens lost their feathers, and grew a coat of scales, and the d—d carp lost their scales and grew a heavy coat of feathers!" (Great laughter and applause).

President: That is a case of hen-pecked carp. (Laughter).

Mr. Seymour Bower: In Michigan, down in Monroe county, especially, where there was formerly a great deal of prejudice against the carp, it now has many friends; because fishermen have learned how to catch and hold them so as to make money out of them, which they are now doing; and where formerly they were cursing the carp, they are now sounding his praises.

RECENT ADVANCES IN LOBSTER CULTURE.

BY MR. A. D. MEAD

Of the Commission of Inland Fisheries of Rhode Island.

When this Society last met in Woods Hole in the summer of 1900, the Rhode Island Commission of Inland Fisheries, in collaboration with the United States Fish Commission, had just begun a series of experiments in the propagation of lobsters, which has been continued since that time with gratifying results.

It is perfectly obvious to anyone in the least acquainted with the life history of the lobster, that its greatest need of protection is during the first few weeks after hatching. The eggs themselves are very well protected by the female lobster until they are hatched, and the young, after they begin their life at the bottom of the sea, burrowing and hiding in holes and under rocks, are comparatively secure. For about two weeks after hatching, however, they are compelled by nature to swim in the water, and during this period their liability to destruction is not only greater than at any other period of life, but apparently greater than that of the young of other sea animals. Their size and bright color make them conspicuous, they lack means of defence, and the agility and, for that matter, the inclination, to avoid enemies.

One further circumstance make it particularly advisable to protect them at this time, viz: that the transition from the precarious swimming stages to the "lobsterling" stage, when they begin life at the bottom, is abrupt. With the third moulting of the skin, the form and habits of the fry suddenly change, and the free swimming fry becomes in about five minutes a crawling lobsterling.

The difficulty of confining newly hatched fry, of feeding them, and of preventing cannibalism, have baffled the many attempts which have frequently been made to protect them through this period. Every conceivable sort of car and enclosure has been tried, with scant promise of success. The fry, left to themselves, are inevitably carried against the side of the enclosure, or sink to the bottom, and perish.

The solution of this difficulty is a simple one. The water must be kept constantly in motion so that the fry cannot sink, and so that the particles of food may be kept suspended and within the reach of the fry. This was suggested by the study of the movement and habits of the fry in confinement at Wickford, late in the season of 1900. Accordingly the last fry of that season (which, by the way, were a poor lot), were kept in motion by means of an oar, and the great increase in the proportion reared to the lobsterling stage was most encouraging.

In 1901 the stirring was done by means of slowly rotating propellers, which were placed in the cars and moved by a gasoline engine. The percentage carried through the swimming stages was raised, from a fraction of one per cent in the experiments of previous years, to fifty per cent in some cases.

In 1902 this apparatus was improved and extended, but the same principle was made use of, viz: that of stirring the propellers, and the results were far ahead of any of those of previous years.

In the first two years of the experiments, before the stirring method was used, less than 100 fry were carried through to the lobsterling stage. At Wickford the record of experiments is as follows:

In 1900, when the stirring with an oar was first tried, the yield was about 3,000.

In 1901, with the introduction of machinery, 10,000.

In 1902, with the improved machinery, 30,000.

The number of fry received during these years was diminished each year.

In 1900 the main problem before us was to devise an apparatus in which the lobster fry could be carried through the swimming stages in large numbers and in good proportion, and this problem has been solved. Incidentally, we might say that the apparatus is also effective in hatching lobster eggs. In designing the apparatus we have kept constantly in mind the possibility of its installation in any protected estuary on any desired scale and at a comparatively small cost. All that is required in the way of an experiment station is a series of skeleton floats buoyed up by barrels or otherwise; the floats may be coupled together and strongly moored. The shafting for transmitting the power from one float to another can be coupled with universal joints and sliding shafts.

It will be surprising if better results cannot be obtained in the future by means of improvements in the apparatus, and through general experience, and I would like to indicate two lines in which improvements should be hoped for. First, in perfecting the transmission machinery, and second, in protecting the fry from parasites such as diatoms and microscopic fungi.

Inasmuch as the lobster is, to a considerable degree, a migrating animal, its cultivation by private enterprise will require its confinement till it reaches the market size, and here several new problems present themselves. Can it live in confinement through the winter? How long does it require to reach the marketable size?

The first question has been satisfactorily answered by the experiments of the Rhode Island Commission. We have kept a considerable number of young lobsters through three successive winters, by sinking them in small cars to a depth of about eight feet in water which becomes quite fresh in the spring, and which freezes at the surface in winter.

The question of the rate of growth has not as yet been fully answered. In our experiments the most conspicuous feature of growth is its great variability; at any time after the first few months, lobsters of the same age are, some of them, twice the length of others. The largest specimens one year of age were three inches; two years, six inches; and three years, eight inches.

The full account of our experiments, with descriptions and pictures of the apparatus, is published in recent reports of the Rhode Island Commission of Inland Fisheries.

DISCUSSION OF MR. MEAD'S PAPER.

Mr. Titcomb: I do not know whether I understood the writer fully. I wanted to inquire if he stated how many lobsters he used to produce the 3,000 and 10,000 and 30,000 he speaks of there.

Mr. Willard: It is not stated.

Mr. Clark: If I remember rightly, three years ago, when the meeting of the American Fisheries Society was held at

Woods Hole, one of our trips was to Provincetown, to view the successes in lobster culture of the Rhode Island Commission in connection with the United States Commission. At that time there was some experimenting going on in the way of rearing, the same as this gentleman mentioned. Now am I to understand that this paper brings the lobster rearing up to date? Is that the idea—bringing that same experiment that we saw being conducted at the Wickford up to date?

Mr. Willard: Yes, that is the idea.

Mr. Clark: Then I understand it is not very successful yet?

Mr. Willard: I think considerable progress has been made, as 30,000 were turned out last year, as against one hundred three years ago.

Mr. Clark: I do not understand that that is 30,000 of the partially grown lobster.

Mr. Willard: Yes.

Mr. Ravenel: It is an increase of from one hundred to thirty thousand in three years. The point is to carry them through the moulting to the lobster stage.

Mr. C. G. Corliss, of Gloucester, Mass.: It seems to me that this experiment depends upon the number of fry used to bring forth this 30,000. That is the meat of the whole thing—of course if they took a million fry and finally succeeded in raising 30,000, it is a question if that is a success. Of course they have progressed as far as increasing the number is concerned; but until we know how many they took to raise such number, we will be uncertain as to whether it was really a success or not. I would like to know how many fry they started with.

Mr. Willard: I regret that our specialist on the lobster is not present; but we have shown a mark of progress in starting in with 100 and arriving at 30,000 in three years, but whether it is really a commercial success at the present time we could not say. We think however, by further experiments and by improved apparatus we can make the number much greater.

Mr. W. H. Boardman, of Central Falls, Rhode Island: Does not Mr. Mead say in his paper that the increase was from 1 to 50 per cent?

Mr. Willard: Yes.

Mr. Boardman: Then that certainly is a great increase.

Mr. Ravenel: He does not say that the increase is 50 per cent. He says 50 per cent in some cases.

Mr. Boardman: I think the proportion is very large that he raises now, that is, that there are very few of them that die. That is a big increase in the percentage.

BLOOD AS FISH FOOD.

BY DR. JAMES A. HENSHALL.

"For the life of the flesh is in the blood."—Leviticus xvii, 11.

Fresh blood, it may be said, is liquid flesh. It contains a large amount of albumen, and lesser quantities of fibrine, fat, and the salts of iron, lime, sodium, potassium, etc. It is food in its most concentrated form. When freshly drawn and allowed to stand it soon cools and separates into clots and the watery portion called serum—the clots being formed of the blood corpuscles and fibrine, and the serum containing the fats, salts, etc.

The separation of freshly-drawn blood into clots and serum can be prevented by briskly stirring it for several minutes, after which a film forms upon the surface, and by keeping it in a cool place it will remain fresh and in good condition for several days

I first began experimenting with blood as fish food two or three years ago, by using the blood from fresh liver, and putting it into the horizontal aerating screens at the head of the hatching troughs, and before the yolk-sac of the fry was absorbed. This was continued until the fry were swimming and old enough to be fed liver emulsion in the usual way.

It was owing to the problem of furnishing suitable food for grayling fry that induced me to try fresh blood from the slaughter house; and although the experiment is still in its infancy, the results, so far, are most favorable and gratifying. This season it has been demonstrated that grayling fry, as soon as they begin to swim, and when too small to take any other form of artificial food, will readily take fresh blood distributed on the surface with a feather.

In the feeding of trout fry, I have also substituted fresh blood for water to dilute the liver emulsion, with the result that they have done better than ever before, growing faster and stronger, and with less mortality. I have furthermore diluted with blood the mush for the adult stock fish. So far as we have progressed with this manner of feeding both fish and fry, the results are so encouraging as to warrant its continuance. The food prepared in the manner stated seems to be better assimilated, and certainly it is taken more eagerly than when mixed with water.

It may be of interest to add that I fed the blood from fresh liver to 100,000 whitefish fry, soon after hatching, and continued its use for several weeks. The experiment was quite successful, as the food was eagerly taken and with evident benefit, for the fry exhibited decided improvement in growth and activity. I imagine that with fresh blood from the slaughter house the improvement would have been still more marked.

DISCUSSION OF DR. HENSHALL'S PAPER.

Dr. Henshall: This paper is very brief and is merely suggestive: it relates to experiments with blood as fish food.

Mr. Willard: Do you mean the Lake White Fish?

Dr. Henshall: The Lake White Fish.

Mr. Whish: I do not desire to occupy too much time, but I can say that the state of New York is paying about $500.00 a month for fish food, and if blood can be obtained and used successfully I should judge off-hand that the reduction in cost would be about 50 per cent. Certainly some of the older members here, who have had experience in feeding fish, ought to give us some facts on this subject.

Mr. Titcomb: I have tried blood as fish food, and I agree with Dr. Henshall that it is very good for fry in the very early stages. It is usually very difficult to get it in the vicinity of hatcheries, but where it is possible to get near a slaughter house, it is a cheap and good food. Blood in the country slaughter houses goes to waste, and all they require is that the fish culturist collect it himself or pay the expense of collecting it. You stirred it while it was warm, did you not?

Dr. Henshall: Yes, sir.

Mr. Titcomb: You have to stir it while it is warm, to prevent it coagulating; but I have an idea that it could be used quite extensively in the vicinity of slaughter houses. I hope the doctor's idea of using it on the grayling will solve a problem there of rearing the grayling, which has not been solved, unless the doctor has solved it this year.

Dr. Henshall: It is too early now to say much about it.

Mr. Clark: Do you say you have not solved that problem?

Mr. Titcomb: Only for a small percentage.

Mr. Clark: I thought perhaps from your remark that you meant to say that you did not rear them at all?

Mr. Titcomb: Oh yes, we have reared some of them.

Dr. Henshall: The great difficulty has been coagulation. But my butchers take it from the animal immediately after it has been slaughtered, they catch the blood in a vessel and stir it briskly while yet warm, producing a homogeneous mixture, and preventing the objectionable separation into clots and serum. By this process of briskly stirring for several minutes the blood will become a homogeneous liquid with a film on top, and by keeping it cool one can preserve it for several days. Where it is convenient to try the experiment I wish you would do so next season. I find that it is the only artificial food that I have succeeded in feeding to grayling at first. Heretofore we have had to provide natural stream water wherein they could find natural food. When first hatched they are only about the size of mosquito wigglers and should be fed the smallest food possible.

Mr. Clark: I should infer from the doctor's paper and what he says, that the one great object in using the blood is its cheapness—not that it is any better than good beef liver.

Dr. Henshall: I think it is better.

Mr. Clark: We raised some grayling fry on liver. Perhaps 500 or 600 out of 5,000 or 10,000, and there was nothing fed but beef liver, we have not fed anything but beef liver in our hatcheries. Some of the older members will remember that I spoke of it at our last meeting. These fry were grown to weigh from one to two pounds, and never had anything but liver.

Dr. Henshall: But you had natural stream water.

Mr. Clark: Natural spring water, and the grayling were raised in spring water.

Dr. Henshall: They would not grow in my spring water.

Mr. Clark: We raised them on liver exclusively, and some of them were sent to the Pan American Exposition at Buffalo, where Mr. Ravenel saw them. Of course the advantage in the blood is perhaps this, that in starting the fry let it be brook trout, grayling, white fish or anything else, it may be a little better on account of being finer, and they might get a quicker start;

but whether it would be better food for the fish as they get older, is perhaps questionable. Of course trying the experiment might determine.

Dr. Henshall: My point was that in diluting the liver emulsion the blood is thicker and better than water, and contains much nutriment. Stir the liver well with the blood. My spring comes from under the Rocky Mountains, and there is neither air nor food of any kind in it. Your spring water probably flows from some little distance?

Mr. Clark: Oh no, it does not. The trout we raise (and I have some of them in my pocket, and you have seen them) were fed liver. Those trout have had nothing but raw beef liver—except the little that they may have been able to get out of the ponds where we put them about a month ago—and they have been fed five months. I have the record right here.

Mr. Titcomb: I would like to inquire of Mr. Whish what he feeds at his hatchery?

Mr. Whish: Beef liver.

Mr. Titcomb: Did you ever try hog's plucks?

Mr. Whish: No, we have always used beef liver.

Mr. Titcomb: Very many culturists are using hog's plucks when it is possible to get them. Hog's livers are about half the cost of beef livers.

Dr. Henshall: I used sheep's liver to a great extent, which costs about one-fifth as much as beef liver. It does very well for larger fish; but being soft does not grind so well, and is therefore, not quite so good as beef liver.

Mr. Clark: We feed hog's liver from the time the fish are a year old and on, but before that I do not like hog's liver in the water—it gives it a milky appearance all the time, and much of it goes to waste. We pay 5 cents a piece for hog's liver and 5 cents a pound for beef, and I think at this price that the beef liver is more profitable, because we get better results for what we pay.

Mr. Atkins: I have been using at the Craig Brook Station in Maine for several years mainly hog's plucks. I use them not because I have thought that they were better than other foods, but because they are more readily attainable in good condition, and are cheaper, and I will not undertake to say that they are any better than some other foods, or perhaps as good; and the only point I can urge in their favor is, that the fish appear to grow well and be healthy on them, and that they are cheap. As to the cost, I have here in my notebook the figures. Last year, 1902, between May and October, that is the principal season of our feeding, we had a stock of fish in which the number of fry have averaged 447,000, that is to say, that is the mean between those we started with and those we closed with; and the fish, one to four years old showed a mean of 5,400, and the amount of hogs' plucks (it was nearly all hogs' plucks) used, was 25,241 pounds; actually fed to the stock 16,408 pounds; cost $262.52. We fed 447,000 fry on the average from May to October, giving us a cost of four and one-half mills per fish, or per 1,000 fish, $4.56. I rather think that is the cheapest we have ever succeeded in carrying any large number of fish through on.

Mr. Titcomb: Have you the cost when you fed beef livers, in comparison?

Mr. Atkins: No, sir, I have not figured this up.

Mr. Titcomb: Is it about twice as much?

Mr. Atkins: I would not dare to say off-hand—I would have to look that up.

Mr. Clark: Our expense bill will run from $15 to $18 a month for 25,000 fish, ranging from one and one-half to four or five years old, we feed beef liver to the smaller fish and to the yearlings, the yearlings taking at least half.

Mr. T. H. Bean took the chair.

Mr. Titcomb: I think it is a very important question from a financial standpoint, and the figures of course won't lie. We have these figures of Mr. Atkins, but we cannot compare them with yours, because the hatcheries are not located where the prices may range the same, but in comparison with the purchase of beef livers which he used previously. Mr. Atkins has made a great saving. Mr. George A. Seagle has made a saving at his station at Wytheville, Va., using hogs' liver, and Mr. W. F. Hubbard at Nashua, in his annual report this last year, gives a statement of a saving of $200 or $300 in the course of a year on fish food, without any evil results, apparently.

Mr. Willard: I understand that the American Fish Culture Company, of Carolina, Rhode Island, one of the owners of one of the largest commercial hatcheries in New York, is using hogs' plucks almost exclusively at the present time, and they would not do that unless it was more economical.

Mr. Seymour Bower: We feed sheeps' plucks costing 5 cents a piece and the net cost is about 2 cents a pound. We prefer them to hogs' liver, which is softer and runs more to waste. Sheeps' liver is almost as firm as beef liver, and is the next best thing to it. It is also more economical, beef liver being very high. During about five months of the year, or in the summer, we alternate the regular food of the adult fish with what we call Lane's food, and Mr. Lane can tell you how it is made. There are corn meal, shorts and animal meal in it. We like it very well. It costs $1\frac{1}{4}$ to $1\frac{1}{2}$ cents a pound, and the trout do well when Lane's food is fed alternately with liver.

Mr. Titcomb: Is that for the young fish?

Mr. Bower: No, sir, for the yearlings and upward. We do not feed Lane's food to small fish—we feed nothing but liver to the young fish. We think our larger fish are better off for not being fed entirely on animal food.

Mr. Seymour Bower: I would like to ask Mr. Wood what he feeds his fish at the present time, and what he thinks as to the relative cost and merits of the kind or kinds of food that he is using.

Mr. C. C. Wood: In the hatchery, at Plymouth, when we are feeding meat, we prefer to feed sheeps' plucks. We think they are better suited to the fish and not as soft as the hogs' plucks, and we get them from the West—they cost us 30 cents a dozen delivered at our hatcheries, with no charge for packing or anything of that kind, and that makes a pretty cheap food, and it is cheaper than anything we can get at Plymouth, and we like the sheeps' plucks better than any meat food. We feed our small fry on haddock spawn, and that makes excellent food; and we have good luck in raising fry; later on, during the summer we feed old fish costing us say \$2.50 to \$3.00 a barrel—old cheap fish that we grind up and feed the older trout. The sheeps' pluck, as I say, is the cheapest and best thing.

Mr. Atkins: From what point in the West do you get the sheeps' plucks?

Mr. Wood: It is a Boston firm, and I have never been able to pronounce it—S & S Company, on Commercial street, Boston.

Q. I suppose they get them from Chicago or western states?

A. Yes, I have no doubt but what they do.

Mr. Seymour Bower: A few years ago I think Mr. Wood told me they bought their sheeps' plucks for 3 cents a piece; but I cannot find a place in the West where we can buy them for less than 5 cents. We buy them direct from the refrigerator car of Swift & Company, which runs through where our hatchery is once a week. They are delivered in very nice shape, but that is the lowest price they ever gave us. I do not understand the reason for the difference in price. I guess we will have to order from Boston.

Mr. Clark: It is on the principle that our manufacturers sell goods in England cheaper than they do at home.

Mr. Bean: I believe Mr. Seagle has had experience in feeding fishes, and I think we would like to hear from him.

Mr. Seagle: We feed our small trout fry, herring roe, and have had some experience in feeding cod roe, but have not been very successful with cod roe. The fish lived but did not grow rapidly, and we quit it.

Mr. Bean: Did you ever try haddock roe?

A. No, sir.

Mr. Bean: Mr. George P. Slade, treasurer of the South Side Sportsman's Club of Long Island, and a new member of our society, is using haddock roe as food. His address is 309 Broadway, New York. He wrote me that the food proved to be very cheap and excellent for the young fry; that the fish grow faster and are less liable to disease than ever before. They had been using liver entirely, but last year they began using haddock roe and they are continuing it very successfully indeed. They get it from Boston.

Mr. George F. Lane, of Silver Lake, Mass.: I do not know that I can give you anything further than I gave you three years ago regarding the so-called Lane Food for fish. I have continued using that same food, as I told the Society at that time, with very good success; and I think if there is any such thing as a commercial fish tasting of the liver, that this feeding of the food that I am given the credit of introducing, is a great benefit to the fish that you are going to put on the market for a food fish.

Mr. Titcomb: What do you feed the young fish?

Mr. Lane: Hog's liver.

THE LIVE-FOOD PROBLEM.

BY CHAS. G. ATKINS.

I think I may safely say that no fish-culturist disputes that live food would be better for fish than dead food if it could be had of suitable kind, in sufficient quantity, and at a reasonable cost. I am not aware that there has been any positive determination of this question by accurate research, but in the absence of such determination I think that we are justified in taking that view. Each one of the species of the family of salmonidae which form almost exclusively the subjects of fishfeeding work in America is plainly by nature a feeder on living animals; to such an extent is this true that seldom will one of these fishes pay the least attention to the most delicious morsel that does not have that most evident characteristic of the traits of life-motion.

The possible sources of live food may be broadly divided into two classes, first, aquatic animals; second, land animals. Amongst the former are other fishes, water-insects, shrimps, daphnids, and other crustacea, water-snails, etc. Amongst the latter are all the aerial insects with such of their larvae as are not aquatic, angleworms, etc.

Of the first group we may note that it comprises the entire natural food of fishes; and it would seem that search for a live food for the fish-culturist's broods should be first conducted along this line. What is there available amongst aquatic animals? The number that might possibly be of some use is so very great that a bare list of their names would take more time in the reading than I can afford in this address. I will therefore confine myself to a very few.

Most prominent among aquatic animals for our present purpose, are the small crustacea of fresh waters, the shrimps and the entomostraca and among the entomastraca, especially the daphnids or waterfleas. Some of these crustacea are present in every fish pond, however small, and under favorable conditions, which nature often gives them, they become very abundant. It is on these minute creatures that young fishes of the salmon family mainly feed in the spring and early summer. In many brooks their influence on the growth of trout has been noted, and there have been some instances in America of fish-culturists availing themselves of their help in growing trout. In the transactions of this Society for 1892 there were some interesting statements from the personal experience of Mr. Fairbanks of Illinois on the growing of trout in ponds in which they were sustained solely by the natural food which grew there spontaneously, consisting mainly of freshwater shrimps; and the same matter has been discussed in some of the later transactions. I am not aware, however, that any attempt has been made to forward the multiplication of shrimps by any artificial help further than transplanting them from one water to another.

The crustacea which have received most attention are those belonging to the family of entomostraca called daphnids. Daphnids thrive in water containing much vegetable matter in a state of decay. Not that they feed directly on such material, but on the still smaller creatures that the decaying matter directly nourishes. Decaying animal substances would seem to work in much the same way, the multiplication of some of the entomostraca being eventually much favored thereby.

Fish culturists have always been scheming to utilize these aquatic food resources, but generally with unsatisfactory results. One of the most ambitious of these schemes was that of Lugrin and Du Roveray at Gremat, in eastern France, which was brought to American attention in 1888 by the American consul at Marseilles. His report and translation of a French report on the subject were published in the transactions of this society for 1892. As the consul depicted it, Lugrin's method was very simple and cheap and its results were marvellous. I quote his language: "The process of Mr. Lugrin, which has been patented in several countries, consists in spreading upon the bottom of these tanks a material impregnated with the elements necessary to produce spontaneously a limitless number of Daphnia, Cyclops, Limnaea, as well as fresh-water shrimps, and the larvae of various Ephemera which form the natural aliment of trout and other Salmonidae at all stages of their growth. Once constructed, and impregnated with this producing material—which is of trifling cost, (This reproducing material, it appears from the United States letters patent granted to the inventors, consisted in nothing more nor less than the excrement dropped by the fishes in the ponds), these tanks go on with their work automatically and indefinitely. The water, from two to three feet in depth, being left undisturbed two or three weeks, is found peopled with swarming myriads of minute organisms of the species above named. Twenty thousand trout a year old, or three thousand two years old, which last would average about one-half pound in weight, are considered sufficient for a pasture of that size (160 square yards, or 1-30 acre), and the avidity with which they rush to occupy and ravage their new feeding ground is a delight to the pisciculturist. If the propagation has been ordinarily abundant, these 20,000 young fry or 3,000 yearlings will subsist royally in a tank of the size indicated for an entire month. They will eat on an average twenty to twenty-five pounds of food per day, or 600 to 800 pounds per month. When,at the close of the month the tank has become depleted, the gate is opened and the fish driven like a flock of sheep to a new and similar pasture. The first tank, being closed and left in quiet, immediately begins the process of reproduction, and at the end of two or three weeks is swarming again with the varied minute organic life which far surpasses in value, as food for fish, anything that has been devised by man."

The accounts of Mr. Lugrin's work attracted many visitors; and among them two eminent men in their departments, Prof. Francis Day of England and Mr. Raveret-Wattel of France, are on record as having, from personal inspection, reached the most flattering conclusions as to the success of the method and the great benefits that fishculture would reap from it. But I regret to have to say that their expectations have not been realized. The method of Lugrin, though pushed by the inventor upon the attention of fish-culturists in various countries, has not come into use, and appears to have been found wanting. In 1901, in a book on trout-breeding, we find this same Mr. Raveret-Wattel writing thus about the feeding of the fry: "The food of trout fry in captivity demands minute care and even that will not always avail to prevent heavy losses. One of the principal difficulties is that no artificial food can replace the living prey forming the food of fry that are hatched and live at liberty. When one is raising a small number of fry it is sometimes possible to procure daphnids enough to feed them. In this case one catches some of these minute crustaceans and with them stocks some casks such as are used in kitchen-gardens. * * * * * * * Unfortunately, the plentiful multiplication of daphnids is limited to water warmed by the heat of spring time and can only be applied to the feeding of trout fry in localities where this fish spawns late. Elsewhere one must resort to the foods called artificial, such as curd; yolk of eggs hardened by boiling; sheep's brains; blood, coagulated or cooked; chopped liver of beef or mutton; spleen, etc." Plainly in France the use of daphnids has not yet become an important practice in fish culture; and the same may be said of other countries. At Craig Brook the breeding of daphnids in fish ponds was tried about ten years ago and there appeared at first a prospect of important success; but though the little crustaceans were made astonishingly abundant, the salmon fry introduced into the ponds soon exhausted the supply and it was found impossible to secure its renewal, even though the fish were removed and the pond left to itself. It is a matter of common observation that the season when daphnids especially abound is always the spring and early summer, and it is reasonable to attribute our failure in part to the progress of the season. But Lugrin was able to show his visitors extremely abundant stocks of daphnids and accompanying forms in his ponds in October and again in winter when ice had to be broken to make the examination. I have myself known daphnids to come into a hatchery at Bucksport in winter with the supply-water in such quantities as to clog the flannel screens to the extent of overflowing. In this case the hatchery had just been built and the water supplying it came from a pond that covered a tract of low land now for the first time overflowed. So, although it may be true that the rule is with daphnids, to multiply and replenish the waters in the spring and early summer, and to pass the rest of the year in a dormant state, it seems to be quite within the limits of possibility that, if desirable, they could be produced for fish food at all seasons. I say *"if desirable"* because it would seem that the necessity of using such minute food as daphnids would pass away each summer with the growth of the fish, a trout or salmon having by midsummer become large enough to swallow comfortably an animal many times larger than an ordinary daphnid.

Of the many other aquatic forms that would be acceptable food for young fish, I will take time to mention only the larvae of mosquitoes and similar dipterous insects. In the summer of 1886 and again in 1888 at Craig Brook we practiced for some weeks the feeding of mosquito larvae and pupae to young salmon. At first they were obtained from pools in the neighboring swamps and later from barrels of water that had been set up in convenient places for them, and in which the adult mosquitoes laid the eggs. The fry ate the larvae with great avidity and throve well on them, but other methods of feeding came to engross our attention and the experiments were not carried far enough to develop any practical mode of operation. I, however, think it not improbable that some useful system of managing such larvae might be devised.

Now let us turn to the other division of the subject, the use of living land animals for fish food. First of all stand the larvae of flies. Those that have thus far been tried are almost wholly confined to the species that breed in animal matter, and especially the flesh-flies. At Craig Brook between 1886 and 1896 extensive trial was made of the production and use of these larvae. In 1891, fry of trout and salmon to the number of 158,000 were fed with them exclusively through the most of the summer In later years, when 200,000 fry of trout and salmon were fed through the summer, maggots formed half their food. I have heard of no other attempts at the production of these larvae in America, that were developed beyond the tentative suspension over a fishpond of a box of meat in which the maggots grew and from which they crawled into the water. In Europe there have been numerous experiments leading in some instances to the invention of special apparatus for the purpose, but none appear to have reached the stage of practical work. One of the most prominent of these experimentors was Andreas Rakus, a practical fish-culturist of Austrian Silesia, whose methods, including the culture of many other kinds of live food, were taken up by an engineer, Von Scheidlin, who offered the secrets of the system for sale to American fish-culturists. That part of the system relating to fly-larvae became known as the "Von Scheidlin-Rakus method of odorless production of maggots." Von Scheidlin's description of it is as follows:

"To produce maggots cheaply and in great quantities upon vegetables and beef-blood. Moisture, shade and warmth are the fundamental conditions of the artificial production of insects as fish food. Maggots are produced (by the wholesale) as follows:

"Take a wooden box ½ to 1 meter long, ¼ to ½ meter wide and ¼ to ½ meter deep, wet the whole inside and strew it with sawdust or dry turf-earth so that these shall remain clinging to the walls, and then put in, from the bottom up, in layers of 6 to 10 centimeters, first sawdust or turf-earth, second sterilized (scalded or roasted) bran, third coagulated blood in pieces, together with the serum and chopped up frogs or fish, fourth chopped up plants or boiled mushrooms.. Then again in order, first, second, third, fourth, until the top. Then put the box in warm moist shade. In eight, twelve, twenty-four or thirty-six hours the flies will have deposited their eggs in the mass, and the moist warmth will have hatched them. Should a cold rainstorm occur, then put the boxes in pits in the earth upon fermenting horse manure, and surround them upon the outside with the same, and cover them so that the cool rain water shall not penetrate and hinder the hatching of the eggs. When the fish are being fed, the chest is to be emptied in standing water. In flowing water the contents of the chest must be put in tinned wire baskets having wide meshes, and loaded with stones and sunk to the bottom, otherwise the current will sweep them away."

Perhaps climatic and other conditions are such as to render this a cheap method of producing fish food; but in America the collection of a sufficient quantity of mushrooms to play any important part in the mixture would be impracticable, and the manual processes described would render it rather costly. I doubt, moreover, whether this scheme was ever carried out on more than an experimental scale.

The procedure with maggots at Craig Brook was in outline as follows: Animal substances, which had been exposed to the visits of the flies and received deposits of their eggs were put away in boxes, where the eggs were allowed to hatch and the maggots to grow until they had attained suitable size, when they were taken out and fed to young fish in troughs or small ponds.

The material used was of various kinds. Butcher's offal, plucks or haslets, horses or other domestic animals dying by accident or slaughtered on account of old age, refuse fish, either fresh or dried or salted, all these were used, as each became available. It was found that flies were much more readily attracted by fresh than by very stale material, and therefore anything that had already begun to decay was avoided; though, of course, in every case decay soon set in. In case of dried and salted fish they had first to be soaked in water, and even then the salted fish did not prove so attractive to flies as the fresh material. After the first experiments a house about 28 by 50 feet was built especially for the purpose. This was fitted with ranges of shelves on which were placed the growing-boxes. The boxes were in pairs, one within another. The inner box, smaller by several inches than the outer, had a wirecloth bottom and stood on four legs which held it up from the bottom of the outer box. On the wire bottom was spread a layer of hay, and on this was placed the fly-blown meat, which was generally covered by a light layer of dried loam to subdue the odor. Here the eggs hatched, the young feasted and grew, and in a few days, having attained full size, they crawled down through the hay and the wirecloth into the outer box, whence they could be turned out into a pail and carried to the fish.

The fry receiving this aliment were for the most part reared in wooden troughs a foot wide. At first the maggots were placed on small boards suspended over these troughs and left to crawl off slowly into the water, but later they were strewn in with spoons. They were always eagerly devoured and none escaped. Full-grown maggots were found too large for salmon or trout fry just beginning to feed, and though it was found possible to feed them with half-grown or smaller maggots, the practice finally adopted in the main was to feed liver for several weeks at the start. The maggot-feeding generally began in June and continued until October, when it was customary to liberate most of the fry. It was, however, found possible to keep maggots on hand in a cool cellar the most of the winter, dormant or slowly growing.

Fish fed on maggots have invariably made a better growth than those fed on liver or any other dead materials tried. Thus in 1890 the average weight attained in October by 18,367 salmon fry fed all summer on chopped meat was 45 grains; while 11,479 salmon-fry fed chopped meat until July 4 and maggots thereafter until October attained an average of 51 grains. In 1888 the average of some thousands of maggot-fed fish was 46 grains, against 35 grains for a like number fed on chopped meat. In 1891 the disparity was still greater, 53 grains to 35 grains, as an average of over 40,000 fish on each side.

Whether live food of this character will produce fish of better quality than dead food is a question that should await investigation; I do not mean simply better quality for human consumption, but better for the purposes of nature, making a healthier fish—one more likely to survive in the struggle for existence, and transmit desirable qualities to its offspring. From what has been observed of the influence of various foods I think the presumption fairly lies in favor of the superiority in this respect of this class of fish food.

I regret that I can cite no investigation of the availability for our purpose of the larvae of other than flesh-flies. There are, for instance, the house and stable flies, whose extreme abundance suggests the possibility of breeding and using their young. There are also species that breed in decaying seaweed, and research in other vegetable matter would doubtless reveal many other larvae, of which some might be available. A vegetarian feeder would surely be welcomed, as bringing relief from the disagreeable odors connected with flesh-eating larvae; but I do not consider it improbable that means will yet be found to suppress those odors in good degree while retaining the flesh feeders.

Like many other branches of the fishcultural art, this one of live food has received no thorough study, and presents a great field for future investigation; and as one offering the possibility of discoveries of the very first importance I commend it to all of you who have facilities for experimental work.

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Before reading his paper Mr. Atkins said: I took this subject by request, not that I felt myself in position to handle it as well as I would like to have it handled. My experience has not been sufficiently recent and up-to-date to expect that. I have tried to present in this paper the result of my own observations to some extent, and to glean a little from some other authorities, and hope that the paper may prove of some interest to you.

TRANSPORTATION OF GREEN BROOK TROUT AND SALMON EGGS, RELATIVE TO THE CAPACITY OF THE TWO SPECIES OF EGGS TO BEAR TRANSPORTATION OR ROUGH USAGE.

BY WALDO F. HUBBARD.

This paper is written in the hopes of bringing out some discussion upon this subject, and that members of the Association who have had experiences in this line may relate them. I do not claim to have made any new discoveries, and know that all of the experiments tried by me have been tested by others. But I do claim, as far as my observation and experience have gone, that brook trout eggs will bear transportation in the green stage with less loss than salmon eggs of the same age. What I mean by eggs in the green stage is eggs from one or two, to ten or twelve days old. When I was stationed on the Pacific coast, where I was for twenty-five years in connection with the salmon work, field stations for the collection of salmon eggs were operated in connection with the main station, and it would have often been very desirable if the eggs could have been transferred from these field stations to the main station while in the green stage, and I, at several times, tried a number of experiments with this object in view. As I remember, I shipped the green eggs of different ages by various methods. Some I packed on cotton flannel trays, others in moss, and others in glass jars of water, and I decided, from these experiments, that the eggs could not be successfully shipped until they were eyed, and they were therefore left at the field stations until such period.

In 1899 I was transferred to New Hampshire, where I am now stationed, and where the work consists principally in the propagation of brook trout, though other species are also handled. When I took up this work I gained the impression that brook trout eggs were more delicate than salmon, and, therefore, more difficult to handle, or transport. While in the northern part of New Hampshire my attention was brought to the method employed for several years by the New Hampshire Fish Commission in transferring their trout eggs from the field stations, to the hatchery at Colebrook. The field stations are located ten or twelve miles from the hatchery, and the mode of procedure was, to capture the fish and strip them on the fishing grounds. The eggs, after being fertilized, and washed, were then placed in glass fruit jars filled with water. The jars were filled gradually as the eggs were taken. The work being usually done in the morning and the eggs kept in the jars, with an occasional change of water, till afternoon, when they were taken, by team, to the hatchery; thus being in the jars at least five or six hours. I do not know just what the loss, resulting from the transportation, was, but understand it was very small.

In 1901 the United States Fish Commission was operating a field station on Lake Sunapee, in connection with the Nashua, N. H., station, where both salmon and trout eggs were taken, and, as it would be quite a saving in expense, and avoid a considerable risk, if the eggs could be transferred while in the green stage, to the Nashua station, rather than be left at the field station until eyed, I decided to make the attempt to ship them in glass jars. The results were as follows:

On October 21, 1901, 15,000 brook trout eggs were taken from the field station to Nashua. These eggs were taken from the fish October 15, 17 and 20, therefore the oldest of them would be six days old at the time of shipment. The following day they were picked over and one hundred bad eggs, or about two-thirds of one per cent was found to be the loss. On November 9th of the same year 20,000 salmon eggs were taken from the station in the same manner to Nashua. These eggs were taken from the fish Nov. 5, 7 and 9, so at the time of shipment the oldest of them were four days old. When they were picked over 3,200 eggs, or about 16 per cent was found to be the loss. The following year, 1902, the same field station was operated and the same experiments repeated, with the result that of 16,100 brook trout eggs shipped to Nashua on October 24th, 330, or a little over 2 per cent was found to be the loss. These eggs were taken October 10, 16, 18, 22 and 24, so the first of them were fourteen days old at the time of shipment. On November 11th, 23,000 salmon eggs were shipped to Nashua, and the loss, when they were picked over, was 5,875, or a little more than 25 per cent. These eggs were taken Nov. 6, 7 and 10, and shipped on the

11th, so the oldest of them at the time of shipment were five days. The eggs taken at the Lake Sunapee field station were all handled in the same manner. After being taken from the fish they were placed in hatching troughs where they were kept for several days, in one case as many as fourteen, and until they were shipped to Nashua. At the time of shipment they were placed in two-quart glass fruit jars, the jars being full of water. The covers were then put on and the jars sealed tight. The eggs were placed in the jars before 12 o'clock in the morning, and did not arrive at the hatchery at Nashua till about 8 o'clock in the evening, therefore being in the jars all of eight hours, during which time they were not opened. The jars, containing the eggs, were packed in a box of hay with ice enough in the top to keep the temperature of the water down to about 40 degrees.

To recapitulate: The experiments made by me in Oregon resulted in demonstrating that it was not advisable to attempt to move green salmon eggs. The work done by the New Hampshire Fish Commission shows that green brook trout eggs have been transported by them, with small loss, for several years. The result of experiments made at the Lake Sunapee field station show the loss for 1901 in the transportation of green brook trout eggs to have been about two-thirds of one per cent, and of salmon eggs 16 per cent. In 1902 the loss of brook trout eggs was about two per cent and of salmon eggs 25 per cent.

I understand from J. N. Wisner, Field Superintendent, now in charge of the Clackamas, Oregon, station, and from J. W. Berrian, foreman of the Rogue River, Oregon, station, that at both places they have been successful in transporting freshly taken salmon eggs, in cans while they were in the milt, and before they had been washed, for a mile or two, from the spawning ground to the station, being perhaps two hours on the journey. This, of course, demonstrates that freshly taken salmon eggs can be transported successfully for an hour or two while they are in the milt and before they have been washed, but has no bearing on the question as to whether green salmon or trout eggs will bear transportation with the least loss when they are from one to twelve days old.

DISCUSSION OF MR. HUBBARD'S PAPER.

Mr. Titcomb: I want to inquire the temperature of the water the eggs were held in previous to shipping.

Mr. Hubbard: I could not give it exactly. The water was what we used in the hatching house.

Q. Pretty close to 32°?

A. Oh, no, it was above 40°.

Q. Then the eggs when they were six days old must have been in a very delicate condition.

A. Well, they did not appear to be from the condition they arrived in when they reached Nashua. I think that some of them were in a delicate condition. There were a few eggs that were there twelve to fourteen days old, that were in a delicate condition.

Mr. Clark: At what temperature of water, did you say?

Mr. Hubbard: I cannot say just what the temperature was, but it was over 40°.

Mr. Clark: I made a report six or eight years ago on the same line with the brook trout, when we had a field station for brook trout on the Au Sable river in Michigan, and I made some pretty thorough experiments in transporting green brook trout eggs, to arrive, if possible, at the exact time when they should not be moved, and I think in that report you will find that at a water temperature of 48° to 50° F. the brook trout eggs should not be moved at eight days old. These experiments were conducted as follows: The eggs were all moved about 200 miles by rail; we moved a certain portion of eggs, probably 50,000 to 100,000 each lot each day; they were taken, that is, within a few hours, and then every day from that day on until they were eighteen days old (of course eyed eggs). We found that on the 8th day the greatest loss occurred. The critical stage is about the eighth day, and we can move the eggs with perfect safety before reaching that period, and when that critical stage is reached we do not allow even the trays to be taken out of the troughs.

Mr. Hubbard: How are the eggs shipped—on the trays, or how?

Mr. Clark: The last year we moved about 30 million eggs. and most of them were moved on either flannel trays or cheese cloth trays—I do not think it makes much difference what they are moved on, whether flannel, cheese cloth or wire trays. If you do not have any dead water around them and you have the temperature right I do not think it makes a particle of difference—I would just as soon move them on a board, if that board did not have anything about it that would contaminate or injure the eggs.

Mr. Titcomb: I think Mr. Hubbard's experiments are very interesting; but to carry them to a conclusion, in other words, to determine whether the transportation of the green eggs by the jar method, when they are from one to twelve days old is entirely without injury, we have got at the same time to eye some eggs right at the collecting station, and not only eye them there, but follow the results through to the young fish. I think that very frequently we get trout eggs to the eyed stage, they look all right, and they hatch all right, and then we have weak fry, and we do not know what the trouble is, and in many instances, I believe, although I have never followed a control experiment to prove it, the weakness in the fry and the mortality among the young fish are caused by a weakness in the egg, or possibly the weakness goes back to the parent fish, but will not be noticeable until the fish has begun to feed.

I just want to bring out in connection with this matter the point that many of the superintendents who are making experiments (and I place myself in the same category when I was superintendent), do not carry the experiments far enough; they do not have a test in comparison with the ordinary method. I simply bring that out for consideration, and in connection with your work another year, that you carry the experiments still further. There is no question but that you can take the green trout eggs and carry them long distances with very little injury. You can carry them almost any way. You can take an ordinary fish can and fill it half full of eggs and half full of water and put it on the cars and carry it all day, if you do not get your temperature too high. They get more or less aeration from the motion of the cars, and will go through all right and produce good fry.

Mr. James Nevin, of Madison: We always ship our eggs on wire trays. We fill the top of the tray full of crushed ice, and have no loss from carrying them any distance—whether one day, ten days or two weeks old cuts no figure.

Mr. Atkins: We are in the habit of taking all our salmon eggs two miles from the station, and we transfer them to the station on wire cloth trays, to be developed. And all we have to do when we get them to the station is to take the whole bunch and set it right into the trough; and I have an idea that that could be done many days afterwards with entire success, if we are very careful to avoid jars. As long as we do not expose them far enough to dry them up and do not jar them, we might carry them almost any distance.

Mr. Clark mentioned one stage when he did not even take his trays out. We look them over every week, take them out of the trough, and handle them over, tray by tray; but we are careful not to jar them, and we do not find that we meet with any loss in consequence.

The point I wish to bring out is this, and the experiment that we tried, and I thought that we had it right, is, that in certain stages, with certain kinds of eggs, under certain temperature there is a vital time when we should not disturb the eggs. I think we can kill them then; at other times I do not. My experience has been that this jarring does not affect them either before that stage or after, and I think that a green egg, (that is, provided it is hardened enough—I do not mean an egg that is not hardened, but I mean an egg that is hardened) can be moved with impunity. I would move an egg one, two or three days old just as freely and with just as much jar as I would an eyed egg. But at the vital stage, as I have stated, this can not be done. I would like to ask Mr. Atkins if he has ever tried this experiment with eggs along at different times, picking a tray out and jouncing it in the water to clean it, as hard as he could?

Mr. Atkins: We have tried experiments similar to that.

Mr. Clark: Did you ever have a case like this: Take a tray of eggs, jounce it and pretty nearly every egg will turn white within a very few minutes?

A. Yes.

Q. You do not think that those eggs were all unfertile eggs, do you?

A. Oh, by no means—they were killed by the jar.

Q. Now, have you taken that same process and moved those eggs rapidly in the water after they were eyed, and did you find any trouble?

A. No, not after they were eyed.

Q. Did you ever try them one day, three or four days old?

A. No, I never did.

Mr. Clark: Then try the experiment this winter, and see if you do not arrive at a point when you should let them alone.

Mr. Atkins: There is a point when they are very delicate—we of course know that—and if the eggs are to be taken out of the troughs and handled at that time, it must be done very carefully indeed so as not to injure them.

Mr. Hubbard: Rainbow trout eggs we let lie for the first ten days and then we can handle them.

Mr. Atkins: Our apparatus allows us to handle them at any time.

Mr. Thompson: As being somewhat along the line of Mr. Atkins' remarks, I want to state that while I cannot give the exact figures, I can say in a general way that the eggs from the Sunapee Lake brook trout moved in the manner indicated by Mr. Hubbard have always been amongst the best we have handled at the Nashua Station. The fry hatched from them and reared to the yearling stage being amongst our best and strongest fish. This would definitely indicate that the embryos could not have been greatly damaged by shipping in the manner and at the period mentioned. After the first picking on arrival, there was but small loss of eggs, ranking invariably well up with our best lots; the fish were usually stronger than those hatched either from the station eggs or those received from the Commercial hatcheries.

There is one point I do not think was as well understood as it should be: Not only were the eggs under discussion shipped in fruit jars but after filling them to the top with water and eggs, a rubber band was put on and the jar cover fastened down so that it was absolutely air tight, the same as though preserving fruit. You know the result if air gets in fruit jars. The jars were then placed in the shipping boxes surrounded by packing to keep them from breaking and with a light covering of ice to regulate the temperature. For eight hours at least while in transit to the station there was absolutely no possibility of their receiving any air in addition to that enclosed in the jar.

Mr. Titcomb: What I mean by "comparison" is this: You cannot compare them with the station eggs or the eggs you get from the commercial hatcheries; you have got to make your comparison in order to ascertain the relative merit of transporting those eggs green or young, by eyeing a part of them right where they are taken, and then transporting the balance, getting the comparisons from the same fish under the varying conditions. Undoubtedly the wild trout of Sunapee Lake will yield a stronger trout than the station fish.

Mr. Thompson: I only mentioned that in a general way as it has some slight bearing on the subject.

Mr. Hubbard: I might say that I have had such good success with the jars from the beginning that I have not tried any other way of shipment, as for instance, in trays.

Mr. Clark: How long have you kept the fish in the jars?

Mr. Hubbard: About eight hours.

Mr. Clark: In our work on Detroit river, all our fish eggs were moved from the field station to the hatchery, in cans. They are sometimes taken in the afternoon and do not reach the hatchery until the next forenoon, and are held in cans all that time. The change of water while they are at the field station in tubs. is made every hour. When they are put in the cans it is not intended that they shall be kept there longer than three hours.

Mr. Atkins: Is there no change made during that three hours?

Mr. Clark: No sir, except what little aeration there is in the winter. I think in Mr. Hubbard's experiment if the water is at a proper temperature there would not be a particle of difficulty in sending them in those cans, if you did not have too many eggs for the amount of water.

Mr. Hubbard: They were in two-quart jars, which were probably two-thirds full of eggs.

Mr. Clark: I think there is a point in the sealing business. I conducted an experiment with fish along that line.

Mr. L. B. Handy, South Wareham, Mass.: I take the eggs, pour them right into the pan, not letting them be in water over half an hour, and turn them about 20,000 at a time on the tray, and ship them.

Mr. Clark: Will they come up full size in thirty minutes?

Mr. Handy: Yes, sir, all right. At 9 o'clock in the morning I put them on the tray, and some of them are not taken off until 9 o'clock at night, and they have just a moist cloth over them. I have moved six or seven million of them in the last four or five years that way. When I take them in a jar I find I have a much greater loss from dead water, etc., than by the method which I employ. They do better with no water at all—perfectly dry—than in the way suggested.

Mr. Clark: They must have clear water down our way.

General E. E. Bryant of Madison: I would like to inquire if the deduction from the discussion would be that the mortality of the eggs arises largely, or might arise, from two sources, one, that when they are at a certain critical or sensitive stage, any jarring or throwing them into contact, would impair the virility of the egg; the other, the water becoming stale. Is not then the method which should be resorted to that of the greatest care in handling, to avoid any shock or jar, any bringing of the eggs into forcible contact with each other, and keeping the temperature even and at the degree desired? We know when water becomes stale it becomes infested with myriads of microbes of a bad character; and it would seem to me from the discussion here (and I speak not from actual experience) that the shock or jar was very detrimental to the egg. Is not the problem then to avoid the least shock and to get the temperature right, and to obtain purity of water, if you transport them in water? I merely throw these suggestions out for inquiry.

Mr. Atkins: It seems to me those are the two important points, certainly, to avoid any excessive jar, and also to avoid stale water. I should think that Mr. Hubbard would need, as Mr. Clark says, to extend his observation on those eggs to the hatching and the fry afterwards. I should suppose that it was possible that eggs might be carried in water and show no immediate injury, and show no trouble in hatching, and not until the fish were considerably developed, and then show some weakness as a result of the confinement in water allowed to get stale; but of course Mr. Hubbard had an opportunity to see whether these trout came out right and what character they were, and he can tell us; and as I understand him he observed no injury whatever.

Mr. Hubbard: We had a chance to observe the trout after they hatched, of course.

Q. Those very same ones?

A. Yes, sir, and they were some of the best fry in the hatchery.

Mr. Atkins: That is pretty conclusive.

Mr. Hubbard: I wanted to find out in this discussion how salmon or green trout eggs would bear transportation with the least loss; I do not know if it is very important, but it is quite interesting to me as I had not been able to find means to ship green salmon eggs, and I was very much surprised to find when I came here that the trout eggs would bear transportation with less loss than the salmon eggs.

Dr. Henshall: I made some experiments with grayling eggs when I first began the grayling work in Montana, in order to find out the best time for shipping the eggs, and I have shipped green eggs from the sub-station after shaking and washing them well, for grayling eggs require much more washing than trout eggs, or they will adhere—and after the eggs had a good washing and a chance to absorb all the moisture they would, they were packed on trays in the usual way, and put in my refrigerator cases and shipped to my hatchery with a loss of about 25 per cent. The rest hatched out and made good fry. Those were perfectly green eggs, shipped the same day they were taken. I do not know that I am in order, because I did not hear the original paper, but you were speaking of salmon eggs and trout eggs, and that is my experience with green grayling eggs. We now ship them in less than five days after they are taken.

Mr. Clark: What was the water temperature for that five days?

Dr. Henshall: About 52° F; the eye spots will show in six to seven days, but the embryo is very lively in about five days, and that is a good time to ship them, as they do just as well as when the eye spot shows.

Mr. George F. Lane, Silver Lake, Mass.: My experience with trout eggs at a temperature of 52° is that they should not be handled, after they have been in the hatching trough ten days; if they are touched after the tenth day they are almost a total loss. From the tenth to the twentieth day I do not think they stand touching, according to my observation.

SOME EARLY NOTES ON STRIPED BASS.

BY D. B. FEARING.

In collecting data for a history of the striped bass, I have come across a few remarks concerning him, amongst the early New England writers that may be of interest to the members of the American Fisheries Society:

The striped bass, as he is called here, received his scientific name of lineatus, from Bloch, in the latter part of the Eighteenth Century.

William Wood in New England's Prospect (London 1635) gives "Suggig" as the Indian word for "a Basse."

Josiah Cotton, in his "Indian Vocabulary," gives as the equivalent of "a bass," "qunnammag."

DeWitt Clinton, in a note to his introductory address, before the Literary & Physiological Society of New York, delivered in 1814, states that "Basse is a Dutch word, signifying Perch."

James Mease in a paper read before the same society, says that "The largest rock fish, that is, those that weigh from twenty-five to sixty pounds, are called 'Greenheads;' he also called them 'streaked basse.'"

Storer in his History of the Fisheries of Massachusetts says that "the larger striped bass are called squid-hounds, from the voraciousness with which they will take a squid, when used as bait."

There is a tradition that there were but ten species of fishes, known to the Dutch when they discovered America; that when they caught a shad, they named the fish "Elft," or eleventh; the bass, "Twalft," or twelfth; and the drum, "Dertienen," or thirteenth.

He is found as far north as the Gulf of St. Lawrence, and as far south as the Gulf of Mexico, on the Atlantic coast, and since his introduction to Pacific waters, in 1879, he has become common around San Francisco. He is usually called striped bass from New Jersey, north; from New Jersey, south, he is known as the rock, rock fish or rock bass.

William Hubbard writes in his "History of New England, from the year 1620 to the year 1680" (Mass. Hist. Soc., Collections 2nd Series V): "In the year 1623 they had but one boat left, and that none of the best, which then was the principal support of their lives, for that year it helped them for to improve a net wherewith they took a multitude of bass, which was their livelihood, all that summer. It is a fish not much inferiour to a salmon, that comes upon the coast every summer, pressing into most of the great creeks every tide. Few countries have such an advantage. Sometimes fifteen hundred of them have been stopped in a creek, and taken in one tide."

Francis Higginson writing in 1629 says: "Whilst I was writing this letter my wiffe brought me word that the fishers had caught 1600 basse at one draught, which if they were in England, were worth many a pound."

In his "New England's Plantation" or "A Short and True Description of the Commodities and Discommodities of that Country" (London 1630), he says, "There is a fish called a Basse, a most sweet and wholesome Fish as ever I did eat, it is altogether as good as our fresh Sammon, and the season of their coming was begun when we came first to New England in June, and so continued about three months space. Of this Fish our Fishers take many hundreds together, which I have seene lying on the shore to my admiration; yea, their Nets ordinarily take more than they are able to hale to land, and for want of Boats and Men they are constrained to let a many goe after they have taken them, and yet sometimes they fill two Boats at a time with them."

I find in Thomas Prince, "A Chronological History of New England in the Form of Annals" (Boston 1736), the following: "In the Morning, some of the natives stand at a Distance looking at us, but come not near till they had been a while in view: and then one of 'em holding out a Bass towards us, we sent a Man with a Bisket and change 'em. After which they supply us with Bass, giving a Bass for a Bisket, and are very friendly."

William Wood in "New England's Prospect" (London 1635), says: "The Basse is one of the best fishes in the Country, and though men are soon wearied with other fish, yet are they never with Basse; it is a delicate, fine, fat, fast fish, having a bone in his head which contains a saucerfull of marrow sweete and good, pleasant to the pallate, and wholesome to the stomacke. When there be great store of them, we onely eate the heads, and salt up the bodies for Winter, which exceedes Ling or Haberdine. Of these fishes some be three and some foure foote long, some bigger, some lesser, at some tides a man may catch a dozen or twenty of these in three houres, the way to catch them is with hooke and line; The Fisherman taking a great Cod-line, to which he fasteneth a peece of Lobster, and throwes it into the Sea, the fish biting at it he pulls her to him, and knocks her on the head with a sticke. These are at one time of the yeare (when Alewives passe up the Rivers) to be catched in Rivers, in Lobster time at the Rockies, in Macrill time in the Seas. When they used to tide it in and out to the Rivers and Creekes, the English at the top of an high water does crosse the Creeks with long Seanes or Basse netts which stop in the fish; and the water ebbing from them they are left on the dry ground sometimes two or three thousand at a set, which are salted up against Winter, or distributed to such as have present occasion either to spend them in their houses, or use them for their ground. They drie them to keepe for Winter, erecting scaffolds in the hot sunshine, making fires likewise underneath them, by whose smoake the flies are expelled till the substance remaine hard and drie. In this manner they dry Basse and other fishes without salt, cutting them very thin to dry suddenly, before the flies spoyle them, or the raine moist them having a speciall care to hang them in their smoaky houses, in the night and dankish weather."

Thomas Morton in his "New English Canaan, or New Canaan, Containing an Abstract of New England" (Amsterdam 1637), says: "The Basse is an excellent Fish, both fresh and Salte one hundred whereof salted (at a market) have yielded 5 p They are so large, the head of one will give a good eater a dinner, and for daintiness of diet, they excell the Marybones of Beefe. There are such multitudes, that I have seene stopped into the river close adjoining to my house with a sand at one tide, so many as will loade a ship of a 100 Tonnes. Other places have greater quantities in so much, as wagers have bin layed, that one should not throw a stone in the water, but that hee should hit a fish. I my selfe at the turning of the tyde, have seene such multitudes passe out of a pound, that it seemed to mee, that one might goe over their backs drishod."

As early as 1639 the Colonists seemed aware of the danger of an extinction of their bass fishing, for it was ordered "At the Generall Courte, houlden at Boston, the 22th of the 3th M°, called May, 1639 . . . .

"And it is forbidden to all men, after the 20th of the next month, to imploy any codd or basse fish for manuring of ground, upon paine that every *p*son, being a fisherman, that shall sell or imploy any such fish for that end, shall loose the said priviledg of exemption from public charges, & that both all fishermen, or others who shall use any of the said fish for that purpose, shall forfect for every hundred of such fish so imployed for manuring of ground twenty shillings & so *pp*ortionably for a lesser or greater number; *p*vided, that it shall bee lawful to use the heads & offal of such fish for corne, this order notwithstanding."

Edward E. Bourne tells us in his "History of Wells and Kennebunk" (Portland 1875), "Bass and shad were also very plenty in Mousam river. They were taken in weirs which were built in different places. The most noted place was near the mouth of the river, a few rods above Hart's rocks, or near the old dam of 1792. But soon after the settlement was initiated at Kennebunk, the bass came to the conclusion that it was unsafe to attempt navigation in this river, and discontinued their visits to it."

Writing of Plymouth in 1643 Samuel Davis in his "Notes on Plymouth, Massachusetts; in the Mass. Hist. Soc., Collections, 2nd Series III. (Boston 1815), says: "There is a creek at each of these places (on the headland called Sayquish), where bass were formerly seined; a point there, is still called "stage point," where Mr. William Paddy, about the year 1643, and Mr. John Hewes erected fishing stages, with leave of the colonists. Places where bass frequented would be called "Suckake," hence the "Skekets" at Cape Cod; the word is derived, as we conceive, from "Kicous," the Algonkin generic term for fish; hence, in the Narraganset, bass are called "missuckeke," "much fish," or "great fish," as they are, comparatively, of the lakes; thus from "Kenonge," another generic term. "Hence we think, "Suckicag," the name of Hartford, Conn. It is, doubtless, the little bass creek, there, which is intended, "Muskeget," too, an island near Nantucket, may indicate bass, for fish, we have "Miskenonge," "great fish," applied to the pike of the lakes; and it is also a river, on the map, not far from Montreal."

De Vries in his "Short Historical and Journal Notes of several Voyages made in the four parts of the World, namely, Europe, Africa, Asia and America" (Hoorn, 1655), translated by Henry C. Murphy, in his "Voyages from Holland to America 1632-1644" (published New York, 1853), gives us a different derivation of the name "twalft" for the striped bass. He says, "there is a species of fish which by our people is called the *twelve,* and which has scales like a salmon, and on each side six black streaks, which I suppose is the reason they call it twelve. It is the size of a codfish, very delicate, and good tasted for eating; the head is the best as it is full of brains like a lamb's head. The fish comes from the sea into the river in the Spring about the last of March and April and continues until the last of May. It is caught in large quantities and dried by the Indians, for at this time the squaws are engaged in sowing their maize, and cultivating the land, and the men go a fishing in order to assist their wives a little by their draughts of fish. Sometimes they catch them with seines from seventy to eighty fathoms in length, which they braid themselves, and on which, in place of lead, they hang stones, and instead of the corks which we put on them they fasten small sticks of an ell in length, round and sharp at the end. Over the purse, they have a figure made of wood, resembling the devil, and when the fish swim into the net and come to the purse, so that the figure begins to move, they begin to cry out and call upon the Mannetoe, that is, the devil, to give them many fish. They catch great quantities of this fish; which they also catch in little set-nets, six or seven fathoms long, braided like a herring net. They set them on sticks into the river, one, and one and a half fathoms deep."

John Josselyn in "An Account of Two Voyages to New England" (1638, 1663), published (London 1675), says: "The Basse is a salt water fish too, but not an end (sic) taken in Rivers where they spawn, there hath been 3000 Basse taken at a set; one writes that the fat in the bone of a Basses head is his braines which is a lye."

The Gazette, New York, November 14, 1758, mentions a law which was passed, to prohibit the selling or bringing certain fish called bass or twalft to the City in the months of December, January, and February. In consequence of the great decrease of that kind of fish, and of their being unsound and unwholesome in those months. "The penalty for such offence" was forty shillings lawful money of New York, " and a forfect of such fish." And if it be a negro, mulatto or Indian slave, shall receive such corporal punishment at the public whipping post as the mayor, recorder or aldermen shall think fit, unless the master or mistress shall pay the above fine.

The inhabitants of Marshfield, Mass., in 1762, also endeavored to regulate the catching of bass for, in that year, "At a town meeting was presented a petition of a number of the inhabitants respecting the catching B A S S in the North River, so called in the winter season, which petitioners applied to the General Court to prevent, was laid before the town and after due consideration thereupon, the vote was put to know the mind of the town whether an act may be passed in the General Court for the preservation of those fish and prevent their being thus taken in the winter season, and it passed in the affirmative."

Jeremy Belknap, in the "History of New Hampshire" (Boston 1792), writes: "The bass was formerly taken in great plenty, in the river Pascataqua; but by the injudicious use of nets, in the winter, this fishery was almost destroyed. After the mischief was *done,* a law was made against it; but the bass have never since resorted to this river in any great numbers. It is said by some, that fish which are spawned in rivers, and descend to the sea, return to those rivers, only where they are spawned. If this principle be true, the breed might be renewed by bringing some of the bass, which are caught in Merrimack river, alive, over the land, to the nearest part of the waters of Piscataqua, a distance not more than twelve miles. This must be done before the spawning season, and might very easily be accomplished."

"There was also, till within thirty years, a good *bass fishery* (at Exeter, New Hampshire), through the whole course of the river. But very great numbers having been imprudently, or rather *wantonly* taken in one season, they almost totally left it. For several years past, they have been returning to their old haunts, though in small numbers. Could people be restrained from taking them through the ice, it is thought that the river might again be replenished with them, and the fishery restored. The legislature has passed an act for their preservation; but, through the inattention of those, whose duty it is to guard the laws from violation, it is feared that the generous intention will be frustrated."

Thus writes Samuel Tenney in a "Topographical Description of Exeter in New Hampshire, in Massachusetts." Historical Society Document Collections, 1st Series (Boston 1795) IV.

Charles Brooks in his "History of the Town of Medford" (Boston 1855), has the following anecdote:

"In 1776, a negro named Prince, was at work on the bank of the river (Mystic) opposite the shallow where the ford was, a few rods above the bridge, when he saw an enormous bass swimming very slowly up the river. The tide was inconveniently low for the bass, but conveniently low for the negro. Plunge went Prince for the fish, and caught him! No sooner was he out of water than a desperate spring, such as fishes can give, released him from his captor; and back he falls into his native element; Quick as a steel-trap, Prince springs upon him again, and again clutches him and lifts him up. The fish struggles; and Prince and fish fall together. Again Prince rises, with his prize in his arms, and then brings him ashore. It weighed 65 pounds. Prince thought that such a wonderful fish should be presented to the Commander of the American forces then stationed on Winter Hill. His master thought so too. Accordingly Prince dressed himself in his best clothes, and taking the fish in a cart, presented it to the Commander, and told the history of its capture; And the Commander gave him *six cents!*"

An Albany newspaper of June 10, 1852, says: "A bass of uncommon size, taken in our river, was yesterday brought to our market. Its weight was 55 pounds. We believe this is the largest fish ever caught in the Hudson, the sturgeon alone excepted. It was bought by Mr. Jared Skinner for four dollars and fifty cents."

The largest bass, of which I can find any authentic record, taken with a rod and reel, weighed seventy pounds. This bass was caught by Mr. William Post, at Graves Point, Newport,

R. I., July 5th, 1873. It was in very poor condition, long, thin, and emaciated. If it had been in good condition, it, undoubtedly, would have weighed close to one hundred pounds.

The largest average catch of striped bass, taken with a rod and reel, of which I can find any authentic record, is ten bass, weighing 58, 56, 54, 53, 51, 50, 49, 46, 42 and 36 pounds respectively, or a total of 495 pounds; making an average of 49½ pounds. This catch of striped bass was made on the 29th of August, 1881, between 6 and 11 o'clock a. m., with a heavy sea, and a rising tide, by Mr. Seth Barton French of New York, and Mr. John Whipple of Newport. It is with pleasure that I present to the American Fisheries Society reproductions of photographs of the large bass mentioned above, and also of the large catch of bass taken at the time mentioned.

Authenticated catches of bass weighing 125 pounds have been made in the Chesapeake, seine fishing. Several bass weighing over a hundred pounds have been taken with a hand line.

Probably the most successful introduction of a fish to waters previously foreign to it, has been the introduction of striped bass into Californian waters.

In the report of the United States Commission of Fish and Fisheries, for the year ending June 30th, 1893, we find the following:

The introduction of striped bass was accomplished in 1879, when about one hundred and fifty fish a few inches long, taken from the Shrewsbury river in New Jersey, were successfully carried across the continent, and deposited at the mouth of the Sacramento river by an agent of the United States Fish Commission, co-operating with the California commission. About six months later an example seven or eight inches in length was reported from Monterey, or one hundred miles south of the locality where planted, and in eleven months another specimen twelve and one-half inches long and weighing one pound, was caught in San Francisco harbor. This very rapid growth indicates the special adaptability of the waters of the region to this fish. In 1882 another plant consisting of three hundred fish was made in the same region by the California authorities. As a result of these two small deposits, the species soon became distributed along the entire coast of California. Its occurrence, however, in the other states of the region, has not yet been determined.

Mr. James S. Turner, Secretary of the San Francisco Striped Bass Club, writes me, under date of December 17th, 1902, "last year more than one million pounds of striped bass were sold in the San Francisco markets."

In confirmation of this statement, the Hon. George M. Bowers, United States Commissioner of Fish and Fisheries, writes me under date of January 20th, 1903, "Statistics gathered for 1900 show 1,251,000 pounds in the San Francisco markets in that year."

With such phenomenal results achieved by nature alone in California, why should not our own coasts once more be made to teem with schools of striped bass as of yore?

Mr. E. M. Waterhouse (who read Mr. Fearing's paper): Mr. Fearing will be unable to come until later in the Convention and therefore he has asked me to read his paper. He took me away from the important matter of catching shrimp bait to do this for him.

Mr. Titcomb: Mr. Worth has collected some interesting material relative to the striped bass in North Carolina waters, and I think it would be proper to hear from him.

Mr. S. G. Worth of Edenton, N. C.: I have collected quite a good deal of interesting material relative to the hatching of the striped bass in North Carolina waters within the last three or four months; but I have been unable to digest that matter and get it into report form. I can submit it, however, in some kind of systematic shape now; so what I have to say tonight is, of course, off-hand.

Something that seems to me to be quite an interesting point is that the spawning habits of this fish first attracted considerable attention on the Albemarle Sound while the United States Fish Commission was operating in those waters. It was known before that time that the striped bass laid its eggs in North Carolina and that it had been successfully hatched in that state I think by Superintendent Green, who is present at this meeting. But when the United States Fish Commission ran upon this species spawning at the fisheries at the headwaters of Albemarle Sound and brought in tubs and buckets full of eggs, they were amazed at the quantity and also at the successful hatching which resulted, and considerable attention was attracted to the subject, and it was talked about in Fish Commission circles a good deal. Cases of sporadic spawning of that kind have been noticed on those waters once in a great many years, as they have been in the waters of the Susquehanna river about Havre de Grace. Now had it not been for freshets occurring in the headwaters of those rivers I do not think the Fish Commission would have found those fishes spawning there at all. My observations at Weldon this year led me to believe that those fish were pushed off from the falls, where they naturally lay their eggs, by excessively muddy and cold water, resulting from hail storms and abnormally cold rain fall; so that in that way these fish were pushed out of a locality which the Fish Commission was not frequenting, and came under notice.

About ten or eleven years ago there was an extraordinary report that came up from Edenton, North Carolina, about a catch of striped bass in sturgeon nets. The fishermen in that locality informed me, I being one of their acquaintances, of having put out some sturgeon eleven inch mesh gill nets and catching great quantities of enormous striped bass which were in spawning condition; and it happened at that particular time that I was in a position to make a recommendation, and Superintendent Leary, who is now present, was sent down to Edenton to the headwaters of Albemarle Sound with a field plant, jars, etc., in order to take advantage of any second catch of those fish which might be made; but he was disappointed, and my inference is that it happened to be a favorable year in the Roanoke river for the fish to lay their eggs, and they were not pushed out of these upper waters by cold muddy freshets; consequently he was unable to get any eggs there.

This year on the 15th of April, a party under the direction of the United States Fish Commission office, I being in charge, went to Weldon and pitched a camp there composed of three canvas tents, and an examination was made into those spawning grounds with results that are extremely gratifying. At Weldon, which is about 140 miles from the lighthouse, at the mouth of the river, or head of Albemarle Sound, the fall in the river is very great, perhaps fifty feet perpendicular in a distance about six miles; and it seems as if the striped bass make for those rapids on which they deposit their eggs. They go up there in the months of March and April, and if there is water enough they distribute themselves over the falls this distance of five or six miles. While they are in those falls they are practically inaccessible to fishermen. The river in this distance of five or six miles, where this fifty feet of fall takes place, is very rapid, and is full of islands, boulders, rocks, etc., and the current is so strong that it is apparently dangerous to go in there even when the river is at moderate stages, and when it is high it is really very dangerous; and these fish get up in these numerous channels that pass between the islands, and are inaccessible until the water begins to fall. When it falls to a certain stage the fishermen use finger traps and begin to take those fishes. They are swept out by the current on the finger boards and are captured. As soon as the river falls somewhat lower the fish become uneasy on account of the light covering of water on the falls, and drop below the foot of the falls at Weldon, and from that point down 2 miles there is fishing carried on with dip nets; they are after the manner of the shadskim nets; they are there called drag nets; and these nets are rigged on a bow, and one man sits in the bow of the boat and the other in the stern, paddling, and they float down the river one or two miles and then turn back. There are quite a number of boats engaged in this business, and they catch very considerable numbers of fish there.

With an inadequate crew of men this season—of course not knowing what our needs were there we cut things down as close as possible to determine what was there—from the 6th day of May for a week following we encountered the spawning fish, and I was amazed at the great quantity of eggs that we obtained from the individual fish, and also at the enormous field which seems opened up there for practical work by the United States Fish Commission.

Although the fish were extraordinarily numerous at Weldon this year they got into those Falls and the fishermen were unsuccessful in catching them, so that financially it was a very poor year with them, as I have testimonials to prove in the form of letters—being the worst season in five years.

During this week beginning May 6th, we obtained and subjected to hatching process in hatching jars, 9,000,000 eggs in round numbers; they were estimated on the basis of 25,000 eggs per quart.

I was personally on this river and had the pleasure of taking the eggs from the first fish that was handled this year, which was by estimation a 20-pound fish. I took those eggs myself, impregnated them, washed the milt off of them, and watered them until they were brought up, carried them to the hatchery six miles through the canal from Roanoke Rapids to Weldon, saw them measured and put up in the jars, and they measured sixty liquid quarts, which on the basis of twenty-five thousand to the quart, would be 1,500,000 eggs, from that one fish! My recollection is that during that week there were twelve fish stripped. and the average production from those twelve fish was over 700,000 eggs per fish. That is correct data, on the basis of 25,000 eggs per quart.

There are one or two other points that I will mention. I wish to call attention particularly to one feature of the fishery at that point, which is in the nature of the spawning habits of that fish. For twenty years and more I have heard of the rock fish fight at Weldon, and although I had taken eggs there in two previous seasons about twenty years ago, I never witnessed a rock fight until this year; and this season I saw hundreds of fights, as they term them. When these female fish are in spawning condition the male fish gather around them in great numbers. There will be one big fish, which may weigh five to fifty pounds, as one of them did, which I took eggs from, and she will be surrounded by twenty, thirty or fifty small fish, and sometimes the fishermen will run one of their nets under and catch one of these large fish. and thirty or more of the small fish, and what seemed to be an interesting point in connection with that, is that the small fish appear to be the only male fish that mate with the female. They are known there as perch rock, because they are the size of a perch, and by actual weight they do not weigh as much as two pounds apiece, and yet they seem to represent practically about all there is in the way of male fishes. Those rock fights were interesting. The fishes showed themselves on top of the water and flurried the water and made noises that would attract your attention, so that you would turn around to see the water breaking a hundred yards away. I thought before that that there was a good deal of imagination in it, but I know that it is a fact, and any one can witness it, and when that is going on it is the spawning season, which follows right on the heels of the shad spawning. The rock fish eggs are manipulated practically the same way as shad eggs, except that a lower tank head is required, and the eggs hatch in a period of thirty-six hours.

DISCUSSION.

Mr. Titcomb: Won't you explain the measurement of sixty quarts of eggs out of the twenty pound fish, the way they come up.

Mr. Worth: I had extraordinarily large spawning pans—I think they must have been sixteen inches in diameter—I had bought them at Weldon where the market is limited and had to take anything I could find. I took the eggs in fifteen pans, and ordinarily I should say that I could have taken in those fifteen pans the eggs from forty-five shad, easily, and yet from that one fish the eggs were so numerous that I had to take three more pans and spread the eggs out so as to hold them.

When the eggs are taken they are extremely small and of the most beautiful green I ever saw, and they are quite sticky. I poured water on them continuously while they were water hardening in order to keep them from clinging together.

The fish actually hatched and liberated from those 9,000,000 eggs amounted in round numbers to about 3,000,000 of fish; but our weakest point at Weldon was in the hatchery, where we were not properly equipped—we were short of men and the men in there did not know too much about the business. I had selected them on account of their grit rather than their experience. I think if it had been our second year and with the same conditions that we would have gotten 30,000,000 of eggs, and I believe that we are going to get an average of 75,000,000 or 100,000,000 eggs per season at about the same expense or a little less than running one of our shad hatcheries.

As for the transportation of the fry, it seems as if they would stand any amount of it, but it is going to be a very brief season of work. It seems like swarms of flying ants or swarming bees—it all comes on at once.

Mr. Titcomb: I wanted to have the point of the size of the eggs before they come up, brought out—would not one or two of the pans hold the eggs from that twenty pound fish before the water was applied?

Mr. Worth: Yes, I think so easily—I think that one of them would, I am sure of it.

Mr. Clark: Are the fry free swimmers the same as shad or whitefish?

Mr. Worth: Yes, sir, and not more than three-sixteenth of an inch when they hatch.

Mr. Clark: They do not have a large sac?

Mr. Worth: They have a decided sac—they have so much that they look queer, but yet they are free swimmers.

Mr. Clark: They break right out of the shell and swim away?

Mr. Worth: Yes.

Mr. Titcomb: Won't you explain in the spawning process in the rock fights how this blood is produced which colors the waters?

Mr. Worth: It is assumed by all the fishermen that operate on the river that it is caused by the gashes made by the fishes finning one another in their attempt to get nearer to the spawning female fish. It causes a bloody stain in the water which I did not myself witness, but I know it has taken place, from the great number of persons who told me about it, and that the water was actually discolored with their red blood.

Mr. Titcomb: Do you think you could hold those unripe females in a large pool until ripe?

Mr. Worth: I think it is worth trying, but we made no experiment of the kind. The facilities for trying it are extraordinarily good there.

Mr. Titcomb: Well, if it is possible, you might figure on a thousand million eggs as quickly as a less number, couldn't you?

Mr. Worth: Yes. It is one of the richest egg fields that I know of.

Mr. Clark: What is the time of year of spawning?

Mr. Worth: About full moon, the first week in May, just after the shad.

Mr. Clark: Is the water pretty warm?

Mr. Worth: Yes, the water is about 70° F.

Mr. Clark: Are you not a little afraid in regard to the penning of the females that you might meet with the same difficulty that we found in attempting to pen the shad.

Mr. Worth: Very possibly.

Mr. Titcomb: What was the temperature at that time?

Mr. Worth: About 70° in the river.

Mr. Waterhouse: What is the method of transportation? It is not mentioned in the paper whether the fish are carried in jars cr cans as trout fry are, or how have you transported them?

Mr. Worth: I do not know of any having been carried in cans at all. It has been done I presume, because quite a number were hatched on Battery Island on one occasion. They can be carried just like shad fry, and without difficulty, for I have held them for days in Fish Commission cans with but slight change of water.

Mr. Jones, of Erwin, Tenn.: The canning of rock bass was tried by the Fish Commission at Battery Station about two years before Mr. Ravenell was appointed superintendent, which was during the days when we had a large seine, and we tried to pen the bass and shad, and it proved a complete failure in both cases. The fish became scarred up, and fungused, and the whole experiment was a failure.

Mr. Clark: In the penning at Havre de Grace, we could hold the male fish but not the female. Only three were ever stripped, and they were practically ripe when they were put in the pen.

Mr. Titcomb: What I wanted to suggest about the penning was to hold them back by some arrangement similar to that used on the Pacific Coast with the salmon. I am aware that it would be entirely a gamble, because the river rises very quickly, but if it happened that during the short period of spawning, or perhaps a week or two longer, in order to get your fish, the river did not rise, by the use of salmon racks one would have a pool there very large in area, quite deep, with very swift live water running into it. I was wondering if it was possible in some such case as that to hold the rock fish for a week or two and get those unripe females, because a very large proportion of them are caught and killed.

Mr. Clark: I think experiments in penning wild fish show that the success has been obtained only in the case of cold water fishes. Now with the pike perch I do not think there has ever been any real successful penning, that is holding them any length of time, and I do not think the Michigan Fish Commission ever had any success along those lines. If you will experiment I think you will find that in the case of pretty nearly all the cold water spawning fishes you can hold and collect their eggs, but with the warm water fishes I think you will have difficulty.

Mr. Jones, of Erwin, Tenn.: I will say that I too stripped a twenty pound bass and hatched the eggs successfully. As well as I remember we got something over a million of eggs. They came into the station rather unexpectedly and we constructed an apparatus for hatching them. We constructed a box similar to the old Chester cod boxes, with the tidal motion; and in the absence of suitable jars we used the ten gallon aquaria at Havre de Grace. We hatched the eggs and retained them at the station for about a week after they were hatched, and transported them for a distance of about six miles above the station, in regular transportation cans. We were, I suppose, about an hour on the trip; and they transported very nicely with no loss at all, so far as I could see.

Mr. Ravenel: I have been very much interested in Mr. Worth's observations, and if his statements as to the spawning grounds are correct and verified by experience, he has solved a very important problem in fish culture. As Superintendent of Battery Station from 1886 to 1894, and having direct charge of the station for several years afterwards, I made everyeffort to collect striped bass eggs in that vicinity where there was a most valuable fishery. I have seen 5,000 striped bass in one house in Havre de Grace apparently nearly ripe but only a few spawners were taken in that region, viz., head waters of the Chesapeake Bay during the period mentioned. Just after the shad season is over the boats there catch tons daily; we have never been able to understand why it was that the ripe fish were not found, though an occasional spawner was picked up at some of the fishing shores earlier in the season. The theory presented by Mr. Worth is very attractive; and it would appear as though those sporadic spawners had been forced down by unnatural conditions up the river. If they do spawn in the Rapids, then I think that on the Susquehanna we will look for them up towards Port Deposit, Columbia, and the number of eggs available would be unlimited. I remember the eggs that Mr. Jones referred to, also the first ripe striped bass stripped at Havre de Grace in 1886 and 1887, I think we got 3,000,000 or 4,000,000 eggs—it was a sixty-five pound fish. The eggs were hatched and part of the fry were sent to some point in New York state, I don't remember where just now, but the records of the Commission will show it. Those fry were shipped in shad cans, just as the shad fry are sent.

Mr. Leary: Our fishermen have fished with pound nets in Albemarle Sound. They usually leave the nets in the water for a week and lift them on Saturday. Now if that can be done it seems to me that they might be held in a pen of some sort of material for quite a while. I know that to be a fact, that once a week they lift their nets and take the fish out and sell them. I have seen as many as 600 taken at one lift of the net.

Mr. Worth: I think we should have a barrier or fence to stop the fishes arranged so that they would not know that they were confined. Of course it is one of those things that is worth trying, as it would cost very little to do it. The water is so swift running that a man standing in it has difficulty in keeping his feet even where the water was only two feet deep.

Mr. Bean: I do not know whether the keeping of striped bass in aquaria for a term of years would have very much bearing upon this problem of spawning or not; but it is a fact very well known to many persons that the striped bass is one of the fish that can be kept easily and will grow, thrive and remain there free from parasites, fungus and disease of every kind—in fact it is one of the very best fish of the fresh waters for aquarium purposes. It has been kept in confinement for a long term of years. I know of some bass which must have been kept in New York City as long as eight years, which are in good health, feeding all the time when a fish will feed, (except in winter, when they are in a sort of torpid condition); yet I do not know whether any one has made any observation on the spawning of those fish. Perhaps they never have spawned in those aquaria.

The fact is, they can be kept in confinement with the greatest ease. Now, if they can be kept in a small pool, twenty-eight feet long and three feet deep, what difficulty could be presented in keeping them in a larger enclosure.

Mr. Ravenel: Are they kept in a fresh water pool?

Mr. Bean: The water is made alternately fresh and salt; they have been kept in fresh water as far north as this latitude; and they have been kept in Thunder Bolt Bay, South Carolina, and fed and reared to a great size.

Mr. Clark: It is not the fact of holding these fish and keeping the fish themselves in good condition that is important. The point is, will they develop the eggs. Now we keep the grayling in a pond for years and years, but has anybody ever domesticated the grayling and made a business of taking eggs from graylings in ponds? I know I have tried it a good while, but without success. It is not a question of holding the fish. There is no trouble about holding a great many fish, but the question is, can you pen those wild fish and have the development of the eggs go on until the ripe stage? For instance, last fall with our white fish why did we have a greater number of plugged fish than ever before? We had the greatest number ever known, either by Mr. Bower or Mr. Downing or Mr. Stranahan at his station.

Mr. Bryant: What do you mean by "plugged" fish?

Mr. Clark: Those that you do not get any eggs from. That is, the development has stopped and the vent is plugged. That is the common term. Last year the water was warm, and that is the reason we had so many plugged fish. There is no trouble in keeping the striped bass in good health and all that, but the question is when these fish are penned will they go on and develop?

Mr. Titcomb: You do not understand the kind of penning we propose to do. In this case in the river between the two falls is where the fish lie and spawn anyway; only part of them will go on through. Now what we want to do is to put a rack across in these Rapids. What is the reason they cannot live down there? They do not know they are penned until they get up against the rack—they hardly know they are confined.

Mr. Clark: I do not wish to throw any cold water on this project of trying to pen the fish; I recommend that it be tried. It should not only be tried in the way Mr. Titcomb suggests, but you should try the actual penning in crates. It is well worth trying—but I do not think you will be successful—but that is my say so—I do not know anything about it.

Dr. Henshall: I want to refer to a remark Mr. Clark made about the grayling. I have about thirty graylings four years old which were stripped this spring—they were nearly all males, but the few females were stripped of their eggs which were fertilized and hatched.

Mr. Clark: Then that is the first time it was ever done?

Dr. Henshall: It is only a few, but it is enough to swear by. (Laughter).

Mr. Clark: Did you have any percentage of good fertilized eggs—have you a record of all those things?

A. Yes.

Mr. Titcomb: Is that in your report?

A. Yes.

Mr. Clark: Then it is the first time it was ever done with domesticated graylings.

Mr. Leary: Penning fish has a tendency to prevent spawning; they get excited and go round and round; but try the penning with some material that does not hurt the fish. If you put them in board boxes you will not get anything out of them—use something light and flexible that will not injure the fish.

LETTER FROM HUNTOON OYSTER COMPANY REGARDING SAMPLES OF SEED OYSTERS TAKEN FROM OYSTER BEDS AT SAMISH BAY, DAGGET COUNTY, WASHINGTON.

The Honorable George M. Bowers, U. S. Fish Commission,
Fairhaven, Washington, July 10th, 1903.

Mr. Henry O'Malley, Woods Hole, Mass.:
Dear Sir:—

By Great Northern Express (prepaid) we are today sending you as per above address, two boxes of samples, taken from our oyster beds at Samish Bay—an arm of Bellingham Bay, Skagit County, Washington.

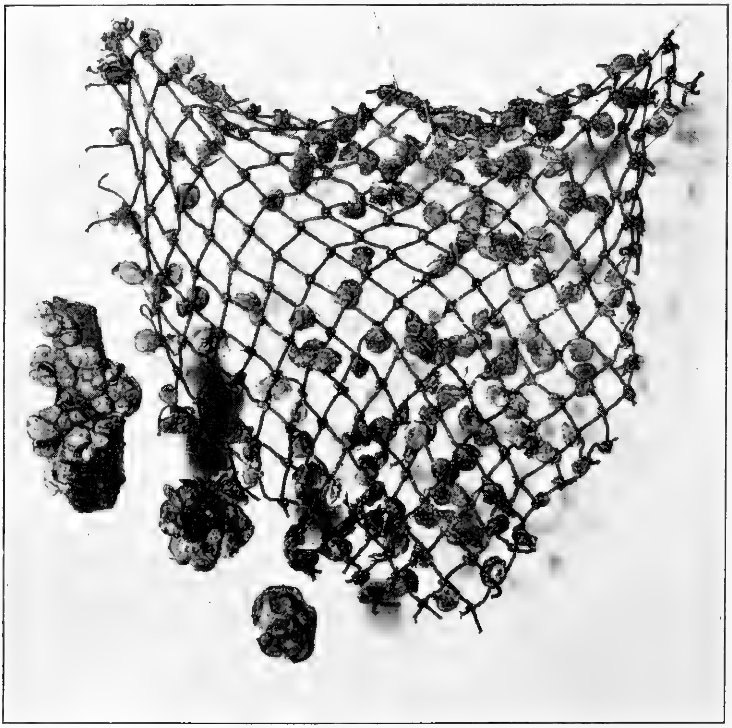
This sample is submitted to show not only the great fertility and richness in native oyster seed of the waters of lower Bellingham Bay, Skagit County, Washington, but to illustrate the method employed by the Huntoon Oyster Company in securing seedlings with which to stock their beds. Material used is cast-off Salmon netting. This particular piece was clipped July 9th, 1903, from a large section deposited in the water on August 20th, 1902. Scrap tin, bark, shells, gravel and other means for taking seed have been tested, but the results of the netting have been the most satisfactory, so far.

Both boxes are marked for "exhibition" and should be taken care of promptly on their arrival. We have packed them in moss as you suggested, but the journey is a long one and the specimens should not be allowed to remain in boxes till the exhibition opens up some ten or twelve days hence. The flat box contains a choice sample of our native oysters, as we caught them in the seed form, the clean webbing having been placed in the waters over our beds August 20th, 1902, so you must agree with us that their showing of growth is something wonderful, ten months after the plain "catcher" was set for spat.

The "catcher" used is cast-off or discarded salmon fishing material and we are fortunate in getting it here at a nominal cost, and its advantages over gravel, sand, bark or brush are many. The Department at one time recommended that we try scrap tin, but that did not seem to do particularly well for us. We are the only people who have tried to take seed with the webbing, but others will follow us this year. We are now spreading our webbing for July and August spat and shall have out over fifty acres, we believe.

We also send you specimen of native oysters taken on shells (clam shells) and on bark. The advantages of the webbing are that we can take the webbing with the seed thereon right to the beds we wish to stock and there shake the young seedlings off on that particular ground without the great labor of picking, and then the web is all ready to place back in position for taking more seed. We propose to let the young seedlings remain on the webbing for a year and then by their weight they are easy to shake off and are large enough to grow and do well. For convenience in transplanting the webbing is the best scheme we have yet tried.

We are placing on our beds this year lots of shingles dipped in



lime and cement and setting them up in pairs, "cone" shape, and shall see if that is as good a method as the webbing. Webbing covers the ground very quickly and completely and at one-tenth the cost of gravel. Gravel and shells, when they become dirty and moss-covered, will not catch spat, but we can take the webbing out and clean it and save all the cost of restocking with gravel. We also show some of our two and three-year-old natives and also two and three-year-old eastern oysters. The Eastern specimens we show were grown on our beds from seed we bought in Connecticut.

We are very hopeful that we shall secure a catch of spat from the Eastern oysters this year and we find many evidences that we have now a set of young Eastern oysters on our beds from last year's spawning.

If we succeed in this propagation of the Eastern oysters in our waters we feel that a great stride has been made in the industry. We are making special efforts along the line of securing seed from our Eastern oysters. The Huntoon Oyster Company was the first to plant Eastern seed in the waters of this end of Puget Sound, and they have done very well for us—have grown and fattened splendidly.

I am mailing you some maps of the Puget Sound country which will be of assistance to you in fixing locations of your Mount Baker plant as well as points on the Sound, when you come to talk with your fellow delegates at the meeting you are about to take part in. We will be very glad to have you make us a call on your way back to the Mount Baker Station, and if any of the Department's representatives are out this way we will be very glad to show them what we have and what we are doing.

If there should be any tests that the Department would like made we will be glad to have their suggestions, and if they send any seed to us for making experiments we will follow directions closely and report on the results. Yours truly,

CYRUS GATES,

Huntoon Oyster Co.

Duplicate of this letter sent to Baker, Whatcom County, Wash.

COMMERCIAL VALUES.

Some Notes of a Study of the Work of the Forest, Fish and Game Commission of New York State.

JOHN D. WHISH, SECRETARY OF COMMISSION.

Mr. President and Gentlemen:—

It gives me great pleasure to stand here as a member of the American Fisheries Society, bringing the official greetings of the Commission having charge of the Forest, Fish and Game interests of the state of New York. Some time ago our courteous and energetic secretary suggested that certain computations which we had been making would be interesting to this meeting and I trust you will find them so. You all know, as practical men, that while some of us are studying the problem of black bass propagation, or endeavoring to find a way to keep the lobster from becoming extinct, others must handle the no less serious problem of providing funds to carry on the work. Somebody must appear before the Legislative Committee and argue for the appropriation; somebody must be prepared to explain to the satisfaction of the inquiring tax-payer just what the people will get for their money, if the required sum is provided.

Over in York state we have a business man for governor, and he has appointed experienced business men as heads of the state departments, as far as possible. Therefore we have the question of income going hand in hand with the question of outlay, and this seems to be particularly the case in matters connected with the forest, fish and game interests. The result has been the confusion of our enemies as one or two practical illustrations will prove. Let me first call your attention to the forests, since these shelter and maintain the waters we stock with fish from our hatcheries. The Commission of which I have the honor to be the secretary, administers for the people a vast woodland estate comprising over 3,000,000 acres in the famous Adirondack region, over 80,000 acres in the historic Catskill mountains, and in addition an extensive pleasure ground on the St. Lawrence river called the International Park. Last year we compiled some statistics calculated to show the money value to the state of these investments, and this was the result: We found that the railroads carried nearly 200,000 visitors to the Adirondacks and over 80,000 to the Catskills, who paid for railroad fares about $875,000. They spent in the Adirondack region alone for board, lodging and the various et ceteras of tourist life, over $5,000,000. Their comfort required the employment there of more than 13,000 persons who were paid wages amounting to nearly a million dollars. So you will see that our forest preserves are beyond attack as a profitable investment.

Now a few words on similar lines with respect to our hatchery system. It is a certainty that the majority of those who spend the large sums I have mentioned to pass a few weeks each year in the forests, go there to hunt and fish,—the most of them to fish. When the springtime stirs the blood, the busy men of our great cities recall the remark of the apostle of old, and seizing rod and creel say to inquiring friends "I go afishing." Most of the great army of summer visitors have the same ambition, and it is to restore to the inland waters the variety of fish necessary to meet this enormous demand that our extensive system of fish culture has been developed. Thirty-five years ago the people demanded that something be done to replenish the waters of New York state with fish. The result was a Commission, a $10,000 appropriation, and one hatchery under the direction of the famous Seth Green. They got quick returns for their investment and now we have a satisfactory system of eight hatcheries, several stripping stations and a distributing car, a plant which at a nominal inventory value is worth $112,000. The cost of running this plant, everything included, averages about $55,000 yearly. Let us see what the people get for their money.

Taking the last fiscal year which ended with the month of September, 1902, the returns from the hatcheries show that they raised and distributed a total of 128,672,516 fish of all varieties. (I may say in passing that the total has shown a considerable decrease for the past three years because of our adopting the policy of distributing less fry and more fingerlings and yearlings, a plan which gives much satisfaction and produces quicker results). Of the grand total distribution, 3,756,000 were trout fry of the various species; 984,150 were trout fingerlings and 284,366 were trout yearlings. The actual value of this product of our hatcheries, estimated on a basis of the prices actually charged by several of the leading commercial fish farms of New England, is: Fry at $3.00 per M, $11,268.00; fingerlings at $20.00 per M, $19,683.00; yearlings at $75.00 per M, $21,327.45, in all $52,-278.00. If you add to this the cost of delivery which is estimated at fully half the value of the fish, the total is $78,278.00, which the people would have had to pay to stock their streams with trout if there were no state hatchery system. This item of itself shows a good return on the investment and the annual appropriation.

Now what of the remaining 123,648,000 fish of various varieties? In this total were 10,000 adult black bass taken from the wide waters of the canal when the ditch was emptied in the Fall. These certainly are worth the highest price charged for adult trout, and are figured at $1,000. The remainder figured at the minimum price for fry, after deducting 14,000 adult rock bass, would be worth at least $123,624.00, making the total value of the product of our hatcheries for 1902, without considering the question of cost of distribution, $176,902.00. It may well be doubted if any other work paid for out of public money can make a better showing.

We are unforunately not yet able to estimate the actual cash value of our inland lake fisheries, but statistics are now being carefully collected to show what these return. Thanks to the United States Commission we have been able to verify our figures on the Hudson river fisheries and find their average yearly value to be about $150,000. With these figures before them, we do not think any legislative committee can be justified in hesitating about making a reasonable appropriation, and it was to remove any such possible hesitation in the future that the figures were compiled. (Applause).

DISCUSSION.

Mr. Root: Is your Association the one that is propagating forest trees from seed?

Mr. Whish: Yes, sir.

Mr. Root: I heard that part of your report and was very much pleased with it. I think that there is a work that has not been taken up before; that the New York Commission are doing a tremendous work in that line—in taking seeds from forest trees and sowing them and thereby renewing the forests. It is a part that certainly struck me as a great work; and I hope all the gentlemen will read that report, for that matter alone, if for nothing else.

Mr. Whish: We find that where there is no forest there is no water. Where I used to fish for trout twenty-five years ago in the Adirondack regions, the sections have been lumbered, and there is no longer any trout stream in the dry season. This last year we lost thousands and thousands of fish because the streams dried up. We had a force of men in the woods and whereever we heard of streams drying up, they would go and net the trout out and put them in other waters. That is one reason why we are trying to restore forest lands, on account of our water supply. A learned work has been written lately to show that there is no relation between the forestry and water. In New York state we think the author is mistaken.

Mr. Titcomb: We certainly do, that is right.

FISH ON THE FARM—WHAT SPECIES TO SELECT.

SAMUEL LOVEJOY.

Living in the red hills of Georgia and never having seen over a quarter of an acre of water is why I select the above subject. The pond should be placed on a stream or supplied from a good spring so as to have a constant supply of water. Side hill ditches should be cut around the pond so as to keep off the surface water during heavy rains, which would soon fill in the pond with clay or sand, although the occasional letting in of muddy water is beneficial, being healthful to the fish, and supplying fertility in which many ponds are deficient.

The area should not be smaller than one-fourth of an acre, though I have seen ponds do well with one-eighth of an acre and even less, where conditions were favorable. The dam should be built well with base ten or twelve feet if six feet high, tapering up to four feet at top. I have noticed a good many ponds in our section where the builder left all the brush in the pond, which is a great mistake, as it furnishes hiding places for fish enemies and makes it bad in case it is desired to capture the fish with nets. The pond should be cleared of all trees, brush, and planted with aquatic plants, not too dense. All ponds should be provided with an overflow or sluice, so as to draw the water entirely out of the pond when desired.

The speckled or mottled catfish, *Amiurus nebulosis,* is very productive, not cannibalistic at all, consumes any good wholesome food, is easily kept and weighs from one-half to three-fourths of a pound when one year old. I have seen it taken at three or four years old weighing from three to five pounds. It is an excellent fish for the table and market.

The blue-gill bream, *Lepomis pallidus,* does well in both northern and southern waters. It is very prolific, a rapid grower, a vigorous biter at the hook, nice for both table and market. Its abdominal cavity and head are very small and it, therefore, dresses to waste but little. It is splendid fish for small ponds. It will live and do well in water temperature up to 100°.

The third best fish, in my opinion, for small ponds south is the warmouth bass, *C galosus.* It grows to much larger size than the bream, thick and fleshy, with large mouth, and is to some extent cannibalistic, but not enough so to make it objectionable. It will eat a few of its own young, but not enough to miss them—just enough to make the balance grow well.

The average weight of the warmouth bass is about one pound, though I have seen them weighing as high as five pounds. They are very easy to raise; will do well in water with a temperature at 100°. I have seen them taken from stagnant water. The warmouth bass resembles the rock bass, with red spots on eyes fore and aft, not as with the rock bass with red spots top and bottom of eye. These three fish are the very best for small ponds and will satisfy any one at the table or market.

One of the greatest mistakes is made in overstocking the ponds and then allowing them to remain so. I have seen ponds stocked with 500 fish and after they are two years old left to remain in the ponds. This is a mistake, after the fish begins to spawn the adults should be taken out as fast as possible so as to allow the young to grow.

Look well to the arranging of the pond and embankment. Then stock your small ponds with the three aforesaid fish and you will succeed.

DISCUSSION OF SAMUEL LOVEJOY'S PAPER.

Dr. Bean (during the reading of the paper): We look on the Warmouth bass as a small fish. The writer of the paper has seen them weighing as high as five pounds, and there is no reason to doubt it; because I have seen rock bass myself from a Virginia river that weighed over three pounds, but we look on the bass in the region in which it is native, western New York for example, and the Great Lake region—as a half-pound fish.

Mr. Titcomb: That is one of the most important subjects we have got before us in this country, I believe, today—I mean the question of fish farming or pond culture in states where they do not have the lakes and streams which we have in New England—out through the west, for example, and the southwest. The Commission is receiving inquiries upon this subject almost every day, about how to construct ponds, and what to stock them with. The main difficulty in writing a paper or preparing any literature for reply to these inquiries rests in the fact that conditions differ so in different parts of the country. If we could get up a paper which would be applicable to all parts of the country, where people want to put in artificial ponds of from half an acre to fifteen or twenty acres in extent, or even larger, it would be one of the most valuable pamphlets for the use of the people at large throughout the country that could possibly be prepared; and in considering that we have to take local conditions into consideration, it is very desirable that we have papers just like the one that Mr. Lovejoy has written, from each state, to show the local conditions.

The main trouble with most people who construct these artificial ponds comes from the fact that they most always choose a ravine or some place that they can throw a dam across, and think they have got a pond, and the following spring they stock it and it goes out, and they are discouraged.

Dr. Bean: I would like to add a few words on that subject, because it so happens that my attention has been most forcibly called to the lack of good common market fish in a number of inland cities. For instance, in Indianapolis, not very long ago I was at a Lumber Convention at the best hotel in the city, and ordered what I supposed would be easily obtained at Indianapolis, because the state is so rich in that fish, a yellow perch, from the bill of fare. Well, the fish was simply uneatable. Now the same experience will be had by any one who goes to St. Louis, for instance, and attempts to order the fish which are indigenous to that state, the crappy, the bass, the Jack salmon, so-called, which is the pike perch, and other common fishes. You simply cannot get them except at the highest priced restaurants in the city. Now, there is no reason why such a state of things should exist, and I presume this is true of almost all the great cities of the United States, barring Boston, New York and a few other cities, which are noted for their fine fish markets; but it is a fact, as Mr. Titcomb has well said, that the ignorance about the methods of supplying the market with fish, and good fish, is deplorable. There is no excuse for it, as far as I can see, except that the people do not know how to get these fish. They have them, and it would be so easy to instruct them as to the methods. For example, we will take a gentleman who lived in Covington, Kentucky, during the time of the Cincinnati Exposition—I have no doubt that Dr. Henshall will remember him—Joe Schlosser—he was a German who learned his fish culture in Germany. He came to Covington and settled in a region where nature made it easy for him to construct ponds, and the work was done at very small cost, because he was fortunate enough to have the graders who were making public improvements put their waste just where he wanted it to make his dams. He had his ponds at different levels and in connection with them he had a great ice-house. He could put his ice into the different floors of his ice-house almost without expense. Then he used those ponds for the rearing of Jack salmon, carp, bass, crappy, and a half dozen of other well-known and excellent table fish. He allowed people to come there and catch what they wanted at a reasonable fixed price. He was always ready to supply large quantities of fish and ice as well. I merely mention this to show that even on a large scale, as Mr. Schlosser conducted his business, it can be made extremely profitable. But the great want is this little bit of information, and I trust that the Federal and State Commissions will publish instructions for making ponds, and give us pictures of the fish that can be reared in those ponds, and describe their food. Of course I know that the United States Commission and some Fish Commissions have done a great deal of this work, but there is not enough of it, because if there were we would not have to go to Indianapolis to get a yellow perch and then not be able to eat it.

Dr. Henshall: I want to endorse every word in the paper just read, and to commend every one of the fishes mentioned. I am very well acquainted with them. When I was President of the Ohio Fish Commission years ago I introduced the marbled catfish. We turned the carp out and substituted the marbled catfish. It is a fish that grows fast, is very good for the table, and will live in any pond that the carp will, and the carp will live in any kind of water, stagnant or otherwise.

Mr. Titcomb: Is it what we call the speckled or channel catfish in Mississippi?

Dr. Henshall: No, it is the nebulosus. In regard to the Warmouth, I have taken them up to three pounds in southern waters. It belongs to the sunfish family, and is more nearly allied to the black bass than any other fish, of that family. It will take fly well, takes almost any kind of bait, and is an excellent table fish. The blue gill exists from Canada to Florida—is another good fish and grows as large and round as a breakfast plate. It has a smaller mouth, will take the fly and is pretty gamey. Both the northern and southern crappies—the calico bass of the north, and the newlight of the south, are excellent pond fish. I do not know that they are excelled by any fish for ponds. All through Kentucky and portions of Ohio they exist naturally and have been transplanted to other ponds and always do well, and furnish a great deal of good food and fine sport.

Mr. Titcomb: For the information of those who may not understand about it, I would say that the Federal Commission propagates and distributes all of these species of pond fishes that have been mentioned. I will ask Dr. Bean about the wall-eyed pike and Jack salmon in the artificial ponds: how small a pond can the Jack salmon be grown in?

Mr. Bean: Mr. Schlosser's ponds were large wide ponds and very deep in some parts—they had twenty odd feet of water in some places.

Mr. Titcomb: What area?

Dr. Bean: Oh they were from two to five or six acres. I was surprised to find Jack salmon in those waters, but there was a fine water supply—in some parts from springs, but largely from surface water also.

Mr. Titcomb: Did the Jack salmon reach a good size in those small ponds?

Mr. Bean: Yes, sir, three, four and five pound fish.

Mr. Titcomb: Was there any quantity of them?

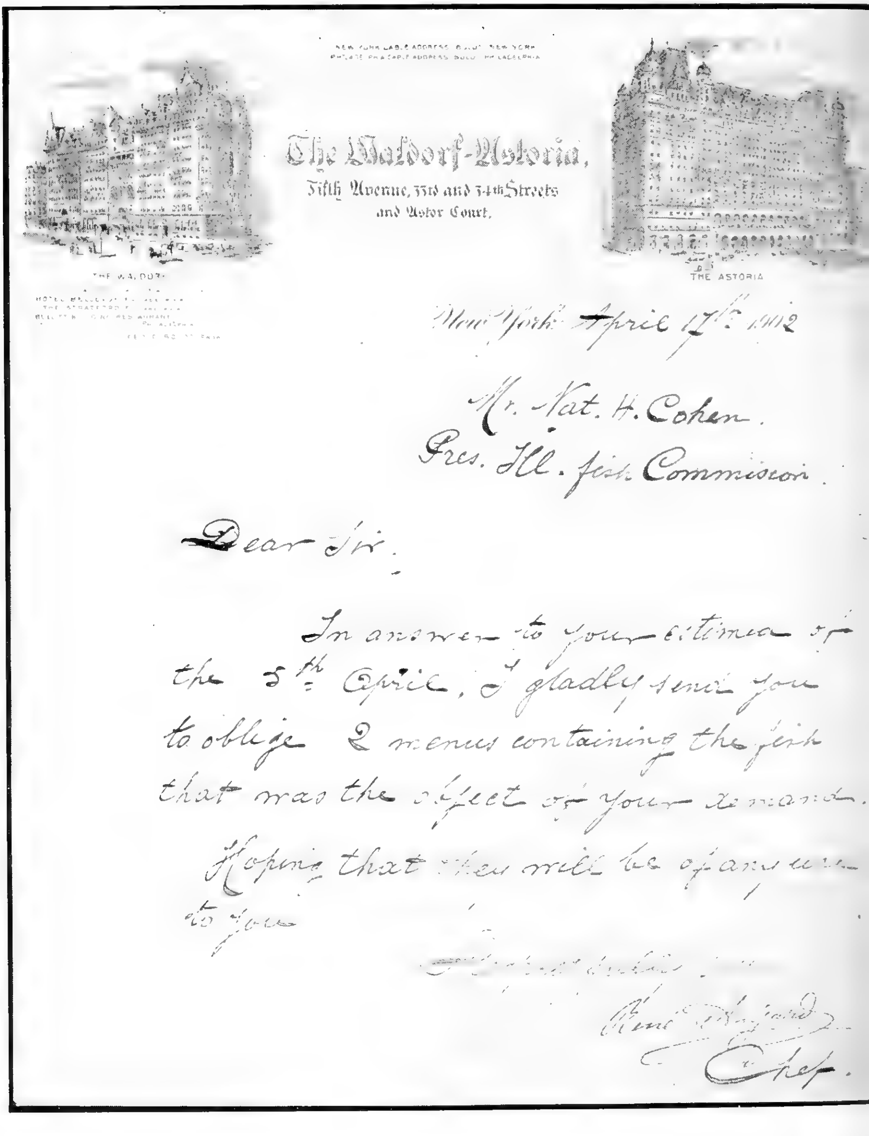
Dr. Bean: Yes, we had a lot of them. It was a surprise to me, and I think I reported upon it at the time in the Commission reports for about 1888—I know I did—because those things always caught my eye. If there were fish around that were good and I thought the people ought to know about them, I always reported them.

Mr. Titcomb: It is interesting to know that we can raise Jack salmon in small artificial ponds.

Dr. Henshall: The Jack salmon or wall-eyed pike is native to the upper Ohio and requires rather deep water, but the ponds referred to were large enough and deep enough; but you will find many wall-eyed pike in the shallow waters of the upper Ohio, as you will find them in the Muskingum and Scioto rivers. I have seen the preserved heads of immense fish from the Ohio river, but they don't exist there now. The Kentucky river used to be famous for them, but since dams have been put in that river, the large fish have disappeared. You will find in the upper Ohio and tributaries, today plenty of wall-eyed pike. In regard to ponds, I only know them in the pond Dr. Bean speaks of, and I can endorse what he says in relation to that.

Mr. Seymour Bower: I would like to endorse all that has been said by the Doctor and others on this paper, which I consider very valuable. It does not cover very much ground, but it is right to the point, and it is certainly very suggestive. I think that most of the states pay hardly enough attention to the propagation and distribution of the common fishes. In our state we have hundreds and hundreds of small ponds and lakes, mostly private waters of a quarter to one-half an acre and up to three and four acres in extent. We have many applications for fish for such ponds. Years ago we took care of them with carp—there was quite a furore over carp twenty years ago. Almost every farmer had a carp pond in his front yard, back yard or barn yard, or somewhere; but there is little demand for carp now. It seems to me this paper is valuable because it gives information indicating how the owners of these small ponds may produce good fish at a very small expense. Of course in our state we cannot supply such fish ourselves, because we are prohibited from furnishing fish for private ponds, except carp, which we do not propagate, but it seems to me that our Commission and others might easily build some ponds of their own for experimental purposes, so that they could at least give out the necessary information. I venture to say we have, accumulated in our offices, from 500 to 1,000 or more applications received during the past four years, for catfish, sunfish, rock bass and perch, and other common varieties that we do not propagate.

Secretary: I have found a couple of papers that relate to the article of Mr. Bartlett of Illinois on the carp. He alluded to having written to the Waldorf Astoria Hotel, having heard that they serve carp, to find out if it was a fact, and he had an electrotype of the letter made and sent on, and I will read it in order to verify his article.



The Waldorf-Astoria,
Fifth Avenue, 33rd and 34th Streets
and Astor Court.

THE WALDORF THE ASTORIA

New York April 17th 1912

Mr. Nat. H. Cohen.
Pres. Ill. Fish Commission.

Dear Sir.

In answer to your estimed of the 5th April, I gladly send you to oblige 2 menus containing the fish that was the object of your demand.

Hoping that they will be of any use to you

[illegible]

[illegible]
Chef.

Secretary: Here is the menu for Wednesday, April 16th, and I call attention to the item "carp, Rhine wine sauce," this

Cafe Luncheon

CAPE CODS 25 **LYNNHAVENS 35** **BLUEPOINTS 25**

Radishes 20 Bieluga Caviare 1 50 Spiced Cantaloupe 30 Sardines 35 Stuffed Olives 30
Lyon Sausage 50 Celery 50 30 Pickled Beets 30 Thon Mariné 40 Anchovy Salad 50
Ripe California Olives 25 Pearl Onions 35 Spring Onions 25 Pin-Money Pickles 20

Cream Parmentier 50 30 **Sagou 35 20**

Petite Marmite 50 Chicken Broth per cup 30 Croûte au pot 40 Tomato Soup 40 25
Chicken Broth, Bellevue 60 per cup 30 Clam Broth per cup 25 Pea Soup 35 25
Strained Gombo 75 Chicken Okra 60 35 Mock Turtle 50 Julienne 40
Green Turtle 1 00 Mongol 40

Oyster Crabs 1 00 60 **Shad Roe 40** **Soft Shell Crabs 1 00** **Shad 80**
English Sole 1 00 **Brook Trout 1 00**

X Carp, Rhine Wine sauce 65 40 Smelts, Melba 75 40 Kingfish, Bonne-femme 85 50
Bluefish, Italian sauce 70 40 Baked Halibut with cream 70
Fresh Mackerel, Maitre d'Hôtel 65 Weakfish sauté with butter 65 40

Eggs Monseigneur 50

Broiled Mushrooms 1 00 **Terrapin 3 00**
Lamb Chops, Fremeuse 70 40 **Fried Calf's Brains, Tomato sauce 65 40**
Ham with spinach 65 40 **Aiguillettes of Filet, Poivrade sauce 85 50**
Navarin of Mutton, Parisienne 65 40 **Croquettes Panachées with green peas 65 40**

Roast Lamb 65 40 Roast Squab Chicken 1 25 Roast Chicken 2 00 1 00
Roast Turkey 1 00 60 Roast Mutton 60 35 Roast Beef 60 40

Broiled Turkey 3 00 half 1 50 Broiled Chicken 2 00 half 1 00 Squab Chicken 1 25 75
Broiled Pullet 3 00 half 1 50 Squab 80 Duckling 2 00 half 1 00
Squab Guinea Hen 1 75 1 00

Canvas Back 4 00 Rail Birds 1 00 Red Head 3 50 Ruddy 2 00 Plover 75
Mallard 1 50 Brant Duck 1 50 Snipe 75

Potatoes Pont-Neuf 30 20 **New Asparagus 1 00** **Okra, German style 50**

Beets 30 Spinach 40 Sweet Potatoes 30 Cauliflower 60 Boiled Potatoes 25 15
Fried Egg Plant 40 25 Succotash 40 Squash 40 Fresh Artichoke 60
French Asparagus 1 25 Onions 40 25 Plain Rice 20 Stuffed Tomatoes 60
Braised Lettuce 60 Bermuda Potatoes 30 20 Lima Beans 50
Mashed Turnips 40 Fresh String Beans 75 Sweet Red Peppers 50
Stewed Tomatoes 30 Oyster Bay Asparagus 75 Cêpes 60

COLD

Game Pie 1 00 60 **Brook Trout in jelly 1 00** **Chaudfroid de volaille 1 25**

Lamb 65 40 Tenderloin of Beef 1 25 75 Squab Chicken 1 25 75 Chicken 2 00 1 00
Pickled Pig's Feet 40 Pickled Lamb's Tongue 50 30 Boned Turkey 1 00 60
Crab, Ravigotte 50 Ham 50 30 Virginia Ham 75 Westphalia Ham 75 40
Spring Lamb 1 00 Squab 80 Duckling 2 00 1 00

Watercress 40 25 Lettuce and Grapefruit 60 35 Waldorf 60 40 Lobster 1 00 60
Chicken 1 00 60 Russian 1 00 Romaine 60 35 Dandelion 40 Monk's Beard 40 25
Celery 50 30 Cold Slaw, Egg dressing 40 Cucumber 60 35 Tomato 60 35
Celery Knobs 40 25 Lettuce 50 30 Fetticus 40 25 Chicory 50 30 Escarole 50 30

Gorgonzola 30 20 Gruyère 25 15 Edam 30 20 Brie 30 20 Neufchatel 25
Cream Gervais 25 Roquefort 30 20 Philadelphia Cream 25 15 Port Salut 30 20
English Dairy 25 15 Camembert 30 20 American 20 15
Cheddar 30 20 Stilton 40 25 Canadian 25 Pont l'Evêque 30 20

Strawberries 50 30 King Tangerines 25 Oranges 25 15
Bananas 20 Apples 25 Malaga Grapes 50 30 Pears 60 35 Grapefruit 50 30

Cassava Pudding 40 25 **Kuemmel Omelette Soufflée 50** **Peach Pie 20**
Lemon Custard Pie 20 **Chocolate Baba 30**

Assorted Eclairs 25 Savarin 25 Baba 25 Charlotte Russe 25 Caramel Custard 30
Waldorf Jelly 25 Bar-le-duc Strawberries 40 Fruit Cake 25 Astoria Jelly 25
Assorted Cakes 25 Strawberry Short Cake 50
Bar-le-duc Jelly 40 Apple Pie 20 Pound Cake 25

Apricot, Pineapple, Raspberry, Lemon or Orange Water Ice 25
Strawberry, Vanilla, Coffee, Chocolate or Pistache Ice Cream 25 Mixed 30
Iced Coffee 30 After Dinner Coffee Cup 15 Café Parfait 25 Butter Milk 10

Half Portions are served in Café and to one Person only.

JOHANNIS-LITHIA 40 20

THE WALDORF-ASTORIA Wednesday, April 16, 1902 is on the menu for Wednesday, April 16th. They value carp in New York evidently. (Applause).

Mr. Clark: I think that should go in the proceedings with his report.

Secretary: Certainly.

Mr. Root: I think they put the carp so high that nobody will order it. (Laughter).

Mr. Seymour Bower: Perhaps it was the Rhinewine sauce that carried the order.

Secretary: It is an electrotype—it is genuine—there cannot be any question about it.

President: The date of the menu containing the carp is April 16th, 1902.

Mr. Seymour Bower: Referring back to the remarks of Mr. Whish, during the session of the Legislature last winter we had occasion to collect some information along the same line, and I recall one item that I would like to have incorporated in the proceedings. We addressed a letter to the Superintendent of a certain railroad asking him what he considered the value of the fishing industry to his road, and he wrote us quite a lengthy letter, stating that their management considered (and he went into the details) that it brought them between $200,000 and $300,000 a year for railroad fares alone—that is on one single road in our state, on account of the fishing and fishing resorts in northern Michigan.

Mr. Clark: We have half a dozen other roads equally as enthusiastic.

Mr. Whish: The foxy farmer of the Catskill region has discovered that a stream which has been stocked with fish is a valuable commodity, and he is fencing it off and leasing it to gentlemen who want private preserves, and the railroad companies are making the greatest kind of a kick about it. Just before I came away I received a letter from the attorney of one of the largest roads running in there, saying that something would have to be done to stop this. That is what our railroads think of the value of stocking waters. It is the law that wherever a stream has been stocked by the state of New York it cannot be included in a private park, the water must be open to public fishing. That question is now being tested, and we are waiting very anxiously to see what the Supreme Court of the United States will say about it, because that is where it will eventually be carried.

THREE MAIN POINTS NECESSARY TO SUCCESSFUL BASS CULTURE.

BY J. J. STRANAHAN.

From comparative failure during the two former years of active operations at the Cold Spring, Ga., station of the United States Fish Commission, what might probably be considered a success was attained this year through the radical changes made in three important particulars, and it will be my purposes to confine this paper mainly to these points, which I consider cardinal, in fact, indispensable to successful pond culture and more especially to the production of young black bass.

As will be seen by reference to former papers and remarks presented by the writer to this association, he has been strongly in favor of distributing what has now come to be known as "baby fingerling" black bass. In his annual report two years ago and in special reports to the Commissioner for the past two years he has continually and persistently urged this course, giving as his reasons that all fish so distributed are so much clear gain, as there will be all or more fry left in the ponds after all of these possible have been taken out and distributed that the pond will furnish food for up to the fingerling stage. In these special and annual reports he cited the complete success attending the distribution of small-mouth fry by the Ohio State Commission fifteen years ago, where streams in which this fish were not indigenous became abundantly stocked through the planting of comparatively small numbers of fry.

Of course the conclusions arrived at at the meeting of this association at Put-in-Bay last year, when the Commissioner and his assistant in charge of the division of fish culture were both present, practically settled this question, for, if I remember aright, there was not a dissenting voice after the papers and discussion of the subject were finished, the admirable paper by Mr. Lydell, of the Michigan Commission, making the question practically a closed matter.

It is not, therefore, with a view of changing the opinion of any one that I give the following results at this station this year but rather for the purpose of comparison and to let you all know how we are getting on down in this "neck of the woods." Up to this date, July 18th, 1903, we have distributed during this calendar year 125,420 black bass, of which about 90,000 were baby fingerlings, 1,000 fry and the rest fingerlings. We were badly crippled in our messenger service owing to the shad work in the early part of the season, or we would have distributed 50,000 more bass than we have and this is the reason also why more fry have not been sent out. When we had adequate messenger service baby fingerlings came along as fast as we could dispose of them. In passing I would state that the fry shipped as well as the older fish, although they were sent only about 150 miles. Now, after this distribution of 125,420 bass, we have in the station ponds today more fingerlings than we ever had at this season of the year, or, in the opinion of the attaches of the station. more than was ever before in our ponds at one time.

In concluding on this point I will say that had we twice or three times as many brood fish as we have, there being now 199 adult large mouth black bass in the station ponds, four in number, with a total area of three acres, and with sufficient messenger service so that we could have commenced early shipping fry, we could have easily added from one to two hundred thousand to our output this year, for with this plan of distribution there is no necessity of restricting the numbers of brood fish as would be necessary where only fingerlings are to be produced.

Our baby fingerlings carried practically as well as the fingerlings, in fact in one particular, much better, for by using ice moderately to maintain fairly even temperatures we have been able to ship 1,000 in a ten-gallon can, holding them thus forty-eight hours even in southern Georgia and Alabama in the month of July. Without a single exception, so far as I have been able to find out from our messengers, the applicants have been well pleased with the fish delivered to them, and this is pretty well attested by the large number of new applicants from the territory first covered which have been sent to the Commissioner, much of Georgia having been covered a second time and a new lot still being in reserve.

My next point is the absolute elimination of all fishes from the brood ponds except the species that you wish to propagate.

Even the top minnow, viviparous, which we had supposed to be the least harmful, was found by actual observation to be very destructive to black bass fry. Our best success this year has been where the minnows were the fewest, an effort having been made last fall to clean them all out. This will be repeated the coming fall, and not a living thing in the fish species, aside from the brood fish, will be left in the bass ponds, if it be possible to absolutely annihilate it. Our experience a year ago satisfied us that this should be done. Where we had the most minnows we produced the fewest young bass. Mr. Lydell, in his remarks at the close of the reading of his paper at Put-in-Bay, it will be remembered, advocated this course strongly, saying that he did not know of a minnow which would not devour bass fry when small.

The third point that I would wish to make is not so apparent as the other two, but if you wish to turn out a good lot of fingerlings it is especially necessary, and that is persistent and regular feeding during the breeding season. This is more essential south than north, for here our breeding season lasts over four months, beginning this year on March 1st, when the first eggs were identified positively, although there were several nests well out from shore on the last day of February, and several nests with good lots of eggs being seen on them the early part of July, this long season being caused, I believe, by the females spawning several times in a season, as we know they do here, while they likely deposit all of their eggs at one time in the north. If the fish are fed every other day about all they want and especially well when a rise in temperature follows a cold spell, when the fish will be found to have ravenous appetites, often rushing into a brood of fry and securing a mouthful in spite of the efforts of the parent fish to prevent it, cannibalism will be reduced to a minimum, so far as the adults are concerned.

During the rest of the year the brood fish should be fed enough to keep them in healthy, growing condition or they will not produce good results, and the feed should be mainly fish——we use almost entirely cut mullet from the sea shore—our experience last year, when tadpoles were mainly used, having demonstrated that fish in some form is the best. Of course a change of diet is beneficial and we now give our breeding bass an occasional ration of frog tadpoles which they devour greedily, but this section being very poor in fish life our range in this direction is exceedingly limited. Mr. Seymour Bower, superintendent of the Michigan stations, than whom there is no better authority, says that black bass fed persistently on liver will not produce fertile eggs.

If I were to add another point necessary to success, I would take up the question of cover. Several of our ponds are so poor in bottom soil that the ordinary vegetation of ponds in the vicinity will not live. We have tried fertilization with no success, the fertilizers all washing out the fist year and the vegetation dying. An experiment was last fall made with one of our largest ponds, E, in which we had utterly failed to make myrriophyllum and other like plants grow. About one-third of its area was planted to what is known south as parrot feather, which I have been informed belongs to the same family with myrriphyllum, the writer not knowing its scientific name, it making a much more vigorous growth than any other aquatic plant that I know of and growing such a swamp as to be very undesirable in ponds with fertile bottoms. In this sterile pond the parrot feather proved to be just the thing, making just sufficient cover to thoroughly protect both fry and fingerlings. This pond was a comparative failure last year, while this season it has produced abundantly and it is believed that there are 10,000 fingerlings in it at this time. The dense portions of the parrot feather is alive with fingerlings and has been all the season, the men getting good hauls with the seine by skirting the borders of the vegetation. Another pond of the same size and nearly as sterile, B, has produced as many broods of the baby fingerlings size as the one just referred to, but being almost devoid of vegetation it produced but very few fingerlings, and, when drawn down the other day, less than 200 fingerlings were secured, while a single haul of the seine along the borders of the parrot feather in E on the same day resulted in the capture of over 300 fine fingerlings. It is needless to say that every pond with sterile bottom will be thickly set to parrot feather this season, in fact, we are now at it as fast as time from other work will permit.

To recapitulate: Ship all the baby fingerlings, secured just before the broods break up, with us one to one and one-half inches long, that you possibly can; keep all fish except the kind you wish to propagate entirely out of your ponds; feed enough to keep your parent fish healthy throughout the year and keep them full during breeding season in order to prevent them from devouring large numbers of what will make your fingerlings; see that you have abundant cover to hide your fry, baby fingerlings and fingerlings, and to make a good home for your adults and all else will come to you.

DISCUSSION OF MR. STRANAHAN'S PAPER.

Mr. Lydell: I consider that a very valuable paper and very interesting, and I wish to say that every word that Mr. Stranahan has said in there I believe in. I do not see anything in the paper to criticise.

Mr. Seymour Bower: I had some correspondence with Mr. Stranahan on the subject of feeding adult bass on liver, and what I intended to say was we had no success in feeding them on liver continuously. We do feed liver to the adult bass after the spawning season and feed it more or less all summer, but in the fall of the year we feed minnows, and again in the spring. We found when we fed them on liver the year round the eggs would all blast; and while we think it is all right to feed liver a part of the year we believe they need the flesh of fish in the fall and spring in our latitude in order to make them healthy and of good vitality.

Mr. Clark: I would like to ask if we are to take up the discussion of the bass question now or after all the papers are presented?

President: That is with the meeting. My own impression is that it would probably be better to read the papers first and then enter into a general discussion.

Mr. Clark: It is an important question to me because I am an infant in the bass business—I am just commencing—and there are some questions I want to ask. I have been in the business thirty odd years, but I am still a primary school man.

PROPAGATION OF LARGE-MOUTH BLACK BASS AT SAN MARCOS STATION.

BY J. L. LEARY.

Seven years ago when I was ordered to San Marcos, Texas, to superintend the construction of a bass station very little had been accomplished in the way of propagating the black bass. Dr. Henshall had published his book and named him the king of hard fighters, and Mr. W. F. Page, then superintendent of Neosho station, had written his pamphlet for the Fish Commission and had made a beginning in the propagation of bass, as had also Mr. J. J. Stranahan. In fact the five ponds first constructed at San Marcos station, if I have been rightly informed, were planned by Mr. Page, and were the first ponds of the station stocked with this fish. I had previously suggested and found them entirely too small for the work to be accomplished.

Having fished for many years in the Albemarle Sound of North Carolina, where this great inland body of water and its tributaries are the natural home of the large-mouth bass, I was not only well acquainted with their habits of spawning, but knew that the schools of young fish after hatching would seek the shallow flats covered with rush and other water plants to bask in the sunshine and prey on the myriads of insect life that are here produced.

I at once conceived the idea that to make a success of pond culture one must conform as closely to nature as possible, artificially constructing the ponds to resemble the natural haunts of the bass. Therefore I suggested that we build our ponds not less than one-half an acre, and while the ponds be made deep at the draw-off they have a large area of shallow water. My suggestions along this line were adopted and what success I have had is due to making my ponds conform as near to nature as possible.

Now as to stocking ponds with brood fish, the best method, if possible to do so, is to secure good native fish, selecting always the best. This I have done at San Marcos station; however, I have now a fair supply of my own raising. Since I have more pond room for the past three seasons I have carried over each year about one hundred of my best and earliest fish. This selection of choice fish should be made in the spring, when it is possible to do so, and all poor fish liberated. I find fish weighing from two to three pounds preferable for brood purposes. During the winter all my ponds are laid bare and the accumulation of water plants, mosses, etc., taken out and hauled away, leaving the ponds exposed to the air for from six to ten weeks. My brood stock in the meantime are held in very small ponds built for nursery ponds and well fed until ponds are filled and ready to receive them. Then I plant twenty-four fish, twelve pair as near as can be selected, to the half acre of water. This, after experimenting, I have found to be about the right number to obtain good results. I wish it understood that I have no direct way to distinguish sex, except general appearances, but from the fact that our ponds produce thousands of fish it is quite evident that we get them stocked with a fair share of males and females. In spawning the bass follows its natural instincts and will nest on the banks of ponds in from twelve inches to three feet of water. I have, however, tried several kinds of artificial nests, the most successful being a wheelbarrow load of gravel placed around the ponds at intervals of from forty to fifty feet, near the banks and in a variety of depths of water. Many fish take to these gravel piles and they seem to be acceptable to the fish and answer the purpose for which they were designed. This gives each pair of fish plenty of room. Being thus isolated they disturb each other but little and only now and then do we see a fish that is scarred from fighting. My bass commence nesting from the 8th to 15th of February and now and then we have a nest late in June. This has occurred only two or three times in the past six years, and usually with very poor results. I further find that the great loss of young fish is just after hatching, say the first five or six days, before the school becomes active and just after the food sack is absorbed. After this period, provided the water is well supplied with food, the loss is small until the fish attain at least two inches in length and for this reason I never transfer to nursery or shipping ponds fish under one and one-half inches, then they can take food such as chopped fish and crawfish. This food is prepared in the following manner:

If fish, it is skinned and all large bones removed; if crawfish, only the tails are used. This flesh is then placed on a chopping board and chopped very fine. Then it is run through a plate having perforations of 1-32 of an inch. This screening is then mixed with water to the consistency of cream and fed to the small fish. As they increase in size minnows, young carp, and mud shad (Dorosoma cepedianum). The fry of this latter fish is the finest food for young bass I know of and all pond cultural stations should have a pond provided to rear this class of young fish.

I give experiments made with young bass several years ago to determine the most suitable sizes to transfer from brood to nursery ponds and since then no fish have been transferred under one and one-fourth inches in length, they are then fish and can be held with some certainty of getting a fair per cent distributed.

First Experiment.—1,000 young bass one and one-half inches long were placed in a pool six by sixteen feet and one and one-half feet deep. At the end of one month the loss by death was 126, and by cannibalism 139, the greatest loss from death was during the first two weeks. The largest number that died any one day was twelve. These fish were fed on the flesh of perch prepared as above described.

Second Experiment.—1,000 fry just after food sack was absorbed were placed in a pool six by sixteen feet and one and one-half feet deep, supplied with small insects gathered in moss from river, and many water fleas (Daphnia). After the third day they commenced to die, the greatest loss was seventy-one in one day, and at the end of the month there remained, in round numbers, 200, and these were not in good condition.

Third Experiment.—1,500 young bass from two to two and one-half inches in length were placed in a section of pond sixteen by fifty feet. This pond had a fine growth of water plants (Myriophyllum) and in it were great quantities of insect life. These fish at the end of the month were in fine condition; 1,240 were shipped out and distributed. The result showed a loss of 260, and ten of these died from effects of handling during transferring. The 250 lost I attributed to cannibalism.

Fourth Experiment.—5,000 fry (number estimated) were placed in section of pond sixteen by sixty feet. At the end of one month 750 were found. This pond was well supplied with water plants and apparently full of insect life. This was rather an extravagant experiment, but the result of the combined experiments shows conclusively that young black bass should not be transferred from brood ponds during the fry stage. During my feeding of the small fish I tried maggots which were readily taken.

When transferring young fish not only should great care be exercised but very soft material should be used in making the seine. I find bobbinet in every way satisfactory. I get two bolts, twelve yards to the bolt and three yards wide. This I rig into a seine nine by sixty feet. The twelve feet taken up gives plenty of bag. The top line is well supplied with floats and the bottom line quite heavily leaded to make it sink quickly. On the bottom line about six feet apart I place a cedar float one and one-fourth inches in diameter and five inches long. The purpose of this float on the bottom line is to keep the seine from rolling in ponds full of water plants. With this seine I can surround an entire school and in the bag of such a net very few fish can escape. We have landed as many as 6,000 at one haul.

These fish are placed in nursery pools and held for shipment. being fed as above described. Nothing but fish are distributed from San Marcos station, varying in size from two to six inches in length and the results from our plants have been satisfactory.

My black bass have done splendidly this season and I still adhere to my plan of plenty of room with an abundance of food if one wishes to be successful with the black bass.

DISCUSSION OF MR. LEARY'S PAPER.

At the beginning of the paper Mr. Leary said: I speak of the Fish Commission because I do not know of any others that had commenced the propagation of black bass before that time.

I can further state that the brood stock should be well fed after the season of spawning up to the time they commence to spawn again. I believe we get healthier eggs and better fry in that way. You keep your fish in fine condition during the entire season after spawning. (Applause).

Mt. Atkins: Do you feed during the spawning season?

Mr. Leary: Occasionally I do, about once a week during the spawning season.

Mr. Atkins: How often in other parts of the year?

Mr. Leary: I feed usually twice a week.

Q. Do you think they require less during the spawning season

A. I do. Proof of that is that during the spawning season bass are hard to catch even with the most tempting bait.

Mr. Atkins: I have an idea that possibly it might be worth while to withhold food entirely from them at that season.

Mr. Leary: Possibly it might, but the bass that are not nesting want a little feeding, and those are the fellows that get it.

Mr. Titcomb: What is the length of your spawning season?

Mr. Leary: From about the 8th of February until June—occasionally, as I say, we find a nest in June, but the larger number of nests have always been found in the month of April.

Mr. Titcomb: Wont you explain about the food which you collected for your young fish?

Mr. Leary: The crawfish we collect by seining the pools and an adjoining creek known as Purgatory, and we have secured as many as a barrel at a time, and we carry them home and store them in one of our nursery pools, keep them alive, and all the dead fish we have at that time, or left over from feeding the bass from the Blanco river, mud shad and mullet, we throw in to the crawfish. In feeding we break the tails off the crawfish, skin them and prepare them by chopping very fine and screening, feeding only the tails to the young fish, and the residue of the fish we throw in to the old bass, which they readily take.

Mr. Titcomb: Don't you also collect a lot of small snails?

Mr. Leary: No, because we have an abundance of snails in the ponds—especially at this season of the year when they are throwing off spat and little particles of jelly-like stuff which the fish like, but I do take from the holes of the Blanco river that I can seine, a mud shad, and sucking mullet, we call them down there, I take them home and chop them up. I skin and take the bones out of all the fish that I chop and feed to my fingerling bass.

Mr. Titcomb: You don't cook any food for your fish?

Mr. Leary: I do not. I tried liver and they do not take it readily—of course we want to give them what they like most.

Mr. Titcomb: Did you ever try mush and crawfish mixed?

Mr. Leary: I am of the opinion that mush in any form is not good for bass, in fact they will not take it.

General Bryant: Your fish feed the year around?

Mr. Leary: Yes—it is warm the year round.

Mr. Beeman: What method do you have in handling your fry?

Mr. Leary: I do not handle any because I have had such poor luck in transferring fry that I let them alone until they are about three-fourths to an inch and a quarter long. If fry is going to be handled at all they must be taken from the pond as soon as they rise before the food sac is absorbed, and planted, and if it is suitable water a fair per cent may live.

Mr. Beeman: How do you get them away from the old fish after they are hatched?

Mr. Leary: It is a very easy matter to take a school of young fish, because they school in a body before and after the sac is absorbed.

Mr. Beeman: Do you allow the old fish and young to remain in the same pond together?

Mr. Leary: Up to the time they are three-fourths of an inch long—up to that time the parent fish take care of them.

Mr. E. N. Carter: Do you have any trouble from young bass getting down in the moss?

Mr. Leary: We have a few bass in St. Johnsbury that dive down to the moss, but after using the seine several times the moss will be rolled smooth.

Mr. Carter: Don't you kill any young bass in that way?

Mr. Leary: Very few.

Mr. Carter: How long is the moss?

Mr. Leary: Our moss grows any length there. If the pond is fifteen feet deep it will reach the top. Of course you don't seine the bottom, but your fish after they get to be an inch or three-fourths will school for the top—on a bright sunshiny day after 11 o'clock they will school at the top.

Mr. Lydell: Are these rollers you used, wooden rollers?

Mr. Leary: They are such as are used on net lines.

Mr. Lydell: Then you have to provide lead enough to sink the rollers?

Mr. Leary: Yes, but the roller sinks readily. At the same time it lifts the net least bit when it strikes anything.

Mr. Lydell: We use an iron ring about eight to ten inches in diameter, and attach one about every four feet to the lead line— it answers the same purpose and acts as a sinker at the same time, and our lines do not roll at all.

Mr. Leary: I got a gentleman who owned a muddy cattle tank to allow me to put crappy in there with the privilege of having part of the game fish. I sent out to seine the pond, and they said the pond was so full of mud they could not get the fish. I said I would go out the next day and I could catch the fish. They did not think I could do it; I said "I will show you;" I said "get me a few empty beer bottles"—not full bottles you know—I dare not take a full bottle of beer. (Laughter). I got these bottles, put corks in and tied them at intervals.

Mr. Lydell: Would you not have caught more fish if there had been something in the bottles? (Laughter).

Mr. Leary: I expect I would—I just tied those beer bottles at intervals along that bottom line and got plenty of fish.

Mr. Clark: The last papers are certainly very interesting, and this is a subject that has interested me very much, as I am seeking information on the bass question. We have at Northville a natural place for bass ponds, and we can make any number of nice bass ponds in connection with our trout work. Mr. Bower and Mr. Lydell both say that nature has done for us what they have hunted for nearly a year to find. Some few months ago, or in the winter perhaps, I received instructions from my chief in Washington to prepare for the culture of bass, and was asked to suggest plans for the ponds. I made same sort of sketches and they were forwarded to Washington, and the architect and engineer prepared plans which were forwarded to me to work upon in the building the ponds. You have been talking about the food and the size of your bass, and what you are going to distribute, etc., and I am not up to that, although I might say in passing, I did hatch bass fifteen or twenty years ago, just hatched a few, but not to make a business of it; so that I do not claim to be a bass man at all, and I am an infant in the matter. Now the question that I want to know is, are your bass ponds right? Is the bass pond at Mill Creek where Mr. Lydell and Mr.

Bower are, right; are the ponds at Neosho right, and all these ponds that have been made? Before I undertake this work for the United States Fish Commission I want to know that what I am going to build is the best up to that date. You have got your ponds all built; I am just commencing, and I want to profit by any experience that you may have. Some say they want to be so deep in such a part, and the spawning area wants to be so deep. Now the question I want to get at is, what is right. I can make those ponds practically any depth from one foot to fifteen; now do I want fifteen feet of water, eight feet or six or four for those fish after they come down off the spawning area? And do I want forty or fifty feet of spawning area on the sides of the pond, or do I want less or more? I have the plans here as they are drawn up. I want to have those things fixed right so that I can build at Northville up to date bass ponds. If you people know of something better that you have got, suggest it, and I will have it prepared. I have got five ponds drawn out here on these plans, and those provide, as they were drawn up by the architect and engineer, for a certain depth—of course nothing definite—but I presume drawn something after the style of the San Marcos or possibly the Neosho ponds. But of course they knew nothing about the Mill Creek Hatchery or the Michigan State Commission.

Now this plan provides for a depth of from nothing to two and one-half to three feet in the spawning area, and not to exceed five feet, I think it is, in the deepest part. Now the question arises, is five feet deep enough?

Mr. Leary: Not in your climate.

Mr. Clark: What is the depth of your pond in what we call the "kettle?"

Mr. Leary: In your climate it would have to be deep. My climate is warm and we have no ice. I have one pond of an acre and a quarter nine feet deep at the drawoff, and it goes to nothing. The shallowest point at the drawoff of any of my ponds is five feet.

Mr. Clark: That is in some other pond?

Mr. Leary: Yes, the largest pond I have is nine feet deep at the drawoff; 100 feet from there it is six feet, 100 feet further it is four feet, and 100 feet further it is nothing. At the point last mentioned is my inlet pipe.

Mr. Clark: The point I wish to raise is this: If you could have any depth you want, which I can, up to fifteen feet, what would you make the depth of this kettle?

Mr. Leary: I would make the depth of that kettle as great as I could in your climate, providing that I could draw the water out of that pond. If you can make it ten or fifteen feet and draw the water off, make it so; but you want to have your ponds so that you can draw them off and clean them.

Mr. Clark: The forty feet of spawning area you would have from three feet to nothing.

Mr. Leary: Yes, sir.

Mr. Titcomb: Forty feet margin?

Mr. Leary: Yes, more if you want to. The center of this pond runs down from six feet then to four feet and nothing and comes off either way to nothing. The object of having all that shallow water is that it warms up early in the season and produces a large amount of insect life that the bass feed on, and it produces an early growth of plants, providing shelter and feeding grounds for the fry.

Mr. Clark: I would like to ask the other bass men if what Mr. Leary has said they concur in, especially as to the depths?

Dr. Henshall: I would not recommend anything more than twelve feet in your climate.

Mr. Clark: I will take care of the climate.

Mr. Leary: I think you want more than ten or twelve feet for hibernation.

Mr. Clark: Do we want a good depth of water, or comparatively shallow water, for the bass? The climate is another question. We know what we have to provide for, and the question is, how much depth of water do they require?

Dr. Henshall: Not less than twelve feet.

Mr. Clark: Is that the general opinion of the bass men here?

Mr. Lydell: I am not prepared to state, because we have not a pond with more than six feet of water in it; but we are getting good results from it, and we are further north than Northville. I think ten or twelve feet will do all right; but our pond is only six feet deep, and when we draw it down as low as possible we still have two feet left. We cannot draw the water out of our ponds, because we have not the drainage, and when we draw them that way we seine off everything; and I think perhaps it is beneficial in one way: we do not run all the food out our ponds. When we draw a pond down the food is still in there, and then we seine out every minnow; and I do not know but what it is well to leave some water in the pond—although I have not any pond that I can draw clear down; but I know by not drawing them clear down we have lots of vegetation left, and it starts up quicker than it otherwise would.

Mr. Clark: I do not think there is any question but what Mr. Lydell would, if he could, have every pond so that he could draw every drop of water out, not that perhaps he would want to do it every winter, as Mr. Leary does, but it is preferable to have the pond so that you can draw the water all out for repairs or otherwise.

But the main point it seems to me in regard to this matter is, what is the depth—should the bass have fifteen or six feet. Now would Mr. Lydell, if he could, have twelve to fifteen feet of water in his pond?

Mr. Lydell: Yes, sir.

Mr. Clark: Would Mr. Dean?

Mr. Dean: Yes, sir.

Mr. Clark (to Mr. Beeman): What would you say?

Mr. Beeman: Our ponds have a depth of eight feet over the kettle, and they worked very successfully last winter.

Mr. Clark: Would you have it deeper if you could?

Mr. Beeman: I do not see any absolute need for it.

Mr. Lydell: Do you think the depth of the pond has anything to do with the successful propagation of bass?

Mr. Leary: No, except you want to keep the water from freezing at the bottom; and in a warm climate to have no dead water for big fish to go in. You can have it three feet or 100 feet deep if you can draw the ponds off, but it is necessary to draw them off and get everything out of them. Climatic conditions must be taken into consideration. Aquatic plants grow very profusely wth me, but not so with you, but you can have the water any depth you please, provided you can draw your ponds off and have depth enough to protect from extreme heat and cold.

Mr. Clark: Then I understand that even with the large-mouth bass you would prefer to have the water deep enough so that it will be cool for those fish?

Mr. Leary: Yes, sir, so that they can resort to it occasionally.

Mr. Clark: Most of you people have been handling the large-mouth bass. My instructions from Washington are that I am to handle no large-mouth bass whatever, but all small-mouth, and I have to prepare for the handling, catching and distribution of the small-mouth bass exclusively. Now naturally we have got to the right ground—we have got something perhaps that none of you have. Into every one of those ponds after they are completed I will have my creek water running with a summer temperature of 75° to 80° F., and by turning a valve I can turn in spring water at a temperature of 53° into any pond; and in case the river water is roily at spawning time, I can shut off the creek water, turn the valve from the spring water and put in what is necessary to tide the fish over.

Mr. Leary: You have an ideal location.

Mr. Clark: That is what they tell me, that it is an ideal place, so far as that is concerned; but before making the mistakes that you people have all made, I want to be started right I have made mistakes in fish culture, gentlemen, and many of you are today profiting by the mistakes I have made (laughter), and I propose to step in and profit by the mistakes you have made.

Mr. Waterhouse: I think natural conditions should be imitated as closely as possible. I have discovered no good bass ponds where there is good fishing, where there is not good depth of water, ten or twelve feet at least in the deeper parts, for hibernation, and plenty of shore water besides for spawning purposes, and furnishing a good growth of plant life, and it seems to me in every case where I have had good fishing I had to get a good depth of water—that is a natural condition.

Mr. Beeman: I would like to inquire what the temperature of that spring water is which you propose to supply your pond with in case of roily water?

Mr. Clark: I do not propose to give the bass a temperature of 53° when spawning; but the idea of spring water is to have clear water and perhaps to put in enough of the spring water to take care of the fish, but not to lower the temperature of the water too much; the temperature of the spring water is 50°.

Mr. Beeman: My impression was you intended to close off your main supply and turn in spring water in case of disturbances?

Mr. Clark: Yes, in case of roily water—that I would lower the temperature of the water and destroy the eggs—is that what you are getting at?

Mr. Beeman: Yes.

Mr. Clark: I would not do that.

Mr. Beeman: In case you had a storm of three or four days' duration, would not the spring water lower the temperature of those waters to the danger point?

Mr. Clark: You will notice that the ponds are so arranged that I can, if necessary, obviate any such difficulty as that. The spring water will be put into one pond and that will be exposed of course to the sun and the warm air, and if the worst comes to worse I would only lose perhaps a little in this particular pond where they had spawned. Then the water would go into the other pond at a warmer temperature, probably 70° F. I would not put in a sufficiently large quantity to cool the whole thing—in fact I could not do that—I have not enough spring water. So that the matter of regulating the temperature there I can handle all right, and I can give them clear water. There is no reason why when these ponds are completed there should ever be any roily water in them, if we do not want it there.

Mr. Beeman: The reason I made this inquiry is, I had a little experience at our pond this summer. We were troubled some with roily water there, and in attempting to get around that we shut down entirely. Our ponds were so constructed that I was able to run about four hours with very little fall of surface water, but that was not long enough to prevent roily water coming in; because we had a storm of three or four days' duration. During that time our bass all spawned for the third time and we lost all the eggs, the temperature of the water falling to 59°. Now the air temperature a good deal of the time is about 50°, so you could not depend upon the air temperature keeping the temperature of your ponds up to 70°. If your air temperature is low the temperature of your water would fall.

Mr. Clark: Certainly—if we have a snow storm in June or July up in our country, why, we do not expect to keep a high temperature.

Mr. Beeman: Those conditions did not quite prevail at our hatchery, but I was informed that they did have snow in Boston at that time. But it is possible to have a week's storm where the air temperature would be from 50° to 60°. Under such circumstances the spring water would reduce the temperature of the ponds to a danger point, and that is the point I desire to get at.

Mr. Seymour Bower: I think Mr. Clark's idea is to admit just sufficient water to hold the pond up, merely to offset evaporation. In warm weather the pond exposure will maintain the temperature; it will go down in cold weather, of course. The idea of admitting spring water is merely to maintain the level of the ponds. If the weather is warm you can use the spring all right.

Mr. Clark: I wish to state right here that this idea of the spring water is not original with me—I got this from Mr. Lydell—I do not want to steal some other man's thunder. When I visited Mr. Lydell's place he told Mr. Bower and Mr. Bower told me the same thing, that if they only had sufficient spring water there they would be all right; that if they could turn in spring water to these ponds, in some of these roily times it would help them out; and when they went to my place I showed them what I could do and they said, "do it by all means," and that is where I got my idea of having the spring water piped over there. It may lie there two or three years and never be used to any great extent, but when I have it there it will hold the levels up, and there will be no trouble during a storm of two or three days. How convenient it will be to put on just a little water to keep your pond water going along in just the same condition! Of course if the temperature goes down we cannot help it.

Mr. Lydell: As I understand it, these gentlemen are breeding large-mouth bass, and as Mr. Clark has been instructed to breed only small-mouth bass, he will find he has a different proposition, and will have plenty of chance for experimenting. I do not find any trouble in breeding the large-mouth bass, but the small-mouth bass I find afford considerable opportunity for experimenting; it is not perfected by any means, and Mr. Clark will find that the conditions in his locality will be different than they are at Mill Creek, and he has got to work the problem out for himself, because the conditions are different where he is and where we are.

Mr. Titcomb: I am going to suggest this, inasmuch as Mr. Clark has five ponds to build, that he try all the depths from six up to fifteen feet, say six, ten, twelve and fifteen, or eight, ten, twelve and fifteen, and see what his results are, and then we will have an actual experiment on different depths.

Mr. Clark: That is a good idea; and if a deep pond was found to be preferable, the other ponds could be very easily deepened.

Dr. Henshall: The deep pond is not so sensitive to changes of temperature as a shallow pond, and therefore I should think the deep pond would be better.

Mr. Clark: I have the information I came here for, and that is a general idea of the depth of the pond. I might say that there was a little question of difference in this matter between myself and the Washington people, and we thought it was better to see what the bass people said at this meeting, and I am well satisfied that the general idea is, as far as you have gone, that the deeper the ponds are, the better, but the suggestion of Mr. Titcomb of course, is something which would afford some distinct advantages, and we shall take it up.

Mr. Titcomb: I want to get from Mr. Beeman an account of his work. He has been doing some work with small-mouth black bass, and from what conversation I have had with him I should say that he has learned a good deal about their habits, and I think we can get some valuable information from him.

Mr. Beeman: I came here with the intention of listening, not of saying anything. In fact I do not think it is just my forte to address a meeting, but if there is anything that I can offer of benefit to the Society I shall be pleased to give it. I have had some correspondence with some of the gentlemen here and conversation with them in regard to the amount of bass we produced. At the time I removed the fry from the spawning boxes I had no time to count them. The only way that I could get at the number was to transfer them to a tank that I had built at the north end of the hatchery, and after the first hatch were placed in this tank I had several persons who came there give me what in their opinion was the space occupied by a single fish. The distance was placed at about one cubic inch. After figuring up the capacity of this tank I was somewhat surprised at the result: it gave me 414,720 cubic inches, which, according to the calculations would give the number of small-mouth bass fry that I had on hand. Since talking with some gentlemen here they think it is an utter impossibility, as I had only twenty-four breeding fish in my pond at that time; about one-third of them were males, the other two-thirds were females; but I do not wish to make this statement as absolute—I cannot say that it is the exact number of fish, because undoubtedly it is not; but it gave me some idea of what we might have.

Mr. Clark: These were all small-mouth bass?

Mr. Beeman: Yes.

Mr. Lydell: What size were they?

Mr. Beeman: At that time those that I retained in the nursery ponds were one and one-eighth to two inches in length.

Mr. Clark: I mean adults.

Mr. Beeman: They ranged from one and one-half to four pounds each. The females were the largest. Most of my females were from two and one-half to three and one-half pounds—one or two specimens were nearly four.

Mr. Lydell: We made an accurate count of the roe in a female small-mouth bass weighing one and three-fourths pounds at Mill Creek station this year, and there were 5,000 and some odd eggs in the fish. They were counted by Professor Reighard and myself.

Mr. Beeman: Probably the calculation I have given is not exactly correct; it may be overestimated, but when the bass spawned the second time I counted up the results of one nest, and it produced 6,210 fry; this was a second spawning and there were nowhere near the number of eggs deposited at the second spawning that there were at the first. In fact I observed four cases in the first spawning, where two females spawned in the same nest with the same male, the second female entering the nest inside of twenty-four hours after the first female, and her eggs were deposited apparently right on top of the first eggs.

Mr. Clark: What do you mean by first and second spawning?

Mr. Beeman: I mean after the male bass had cleaned up the gravel in his nest and selected a mate and this pair had gone in, and the female had spawned, she left, and the male remained on the nest, and inside of twenty-four hours I observed another different female was there with this male bass and spawned there. Four instances of this kind I observed at our hatchery this year.

Mr. Lydell: I found the same condition in the large-mouth bass this year. We had two lots of eggs, one lot hatched and there were three or four days before the other came off, and you could distinguish the difference between the two schools of fry.

Mr. Beeman: There was no distinction between the size of the fry, because the eggs were deposited within twenty-four hours of each other, and when the fry rose from those boxes it was a sight to behold. They were so thick you could not see the gravel in the bottom of the boxes.

Mr. Leary: Don't you think it was the same female?

Mr. Beeman: No, sir, there was such a wide difference in size it was easy to distinguish. I am certain that they were different females for that reason.

Mr. Lydell: You are certain that the first lot of eggs laid were not disturbed?

Mr. Beeman: They were not disturbed.

Mr. Lydell: I have had them this year lay one lot of eggs and the male would immediately destroy the eggs, and there would be another spawning with another female, and on examination the eggs were found to be bad.

Mr. Beeman: We had the same fish spawn the third time.

Mr. Titcomb: How long a period was covered by the spawning season from the first fish which spawned to the last one?

Mr. Beeman: The first bed to be taken and spawned on was May 10th, on Sunday morning. Now these are notes that I took, and I have not had an opportunity to refer to them—I just kept a diary noting down some of the interesting things I observed there. I think it was about four days from the time the first bass spawned until the first spawning was completed.

Mr. Lydell: No bass spawned after that time?

Mr. Beeman: No, sir, not during the first spawning.

Mr. Titcomb: What was the total period?

Mr. Beeman: In the temperature of the water there the eggs apparently hatched in between four and five days. The temperature when the first eggs were deposited was 64° F.

Mr. Titcomb: What is the period covered by the three spawnings?

Mr. Beeman: I will look it up.

Secretary: Have you distributed any black bass?

Mr. Beeman: In our lake, yes.

Secretary: About how many have you distributed in your lake?

Mr. Beeman: I distributed the entire two hatches with the exception of about 16,000 which I retained in the hatchery, attempting to raise them up to fingerlings. I held these fry in a tank and supplied them with small crustacea for a week; I planted them after they were removed about a week from the spawning boxes. The second hatching I held in the tank for two weeks and they about doubled their size fed on the crustacea. At that time the crustacea coming in from the river began to fail, and as I had overstocked my nursery pond, having more small bass there than the natural food supply would raise, I was obliged to clean the second crop out of the tank and put them in the lake. About two weeks ago I found the demand in our ponds so great I could not get crustacea enough, so I took out 6,000 an inch and a half long and planted them in the lake—this reduced the number in the nursery ponds so I could keep up with their demands for the crustacea.

Mr. Titcomb: How did you collect crustacea?

Mr. Beeman: I used a net made of cheese-cloth placed on an iron frame three feet square, and these nets were placed in the river where there was a gentle current, which drew the cyclops and daphnia into these nets. They were allowed to remain there for a space of five or ten minutes, and then they were taken out, and as they were drawn out then I reversed the nets and rinsed them off in a tub which contained water, and that removed the small crustacea from the nets. After repeating that operation five or six times I would have sufficient crustacea to take to the hatchery.

Mr. Lydell: How many of these fry did you distribute altogether?

Mr. Beeman: The way I base my calculation, 426,000, but it may be overestimated.

Mr. Nevin: Did these same bass spawn three different times in succession?

Mr. Beeman: Yes, there were no other bass in the pond and we had three different spawnings two or three weeks apart. The second spawning took place almost immediately after the fry from first spawning was cleared up.

Mr. Ravenel: Did you keep a record of the total number of nests at any one time?

Mr. Beeman: During the first spawning nine boxes were spawned in; three of those boxes were lost; consequently there were only six productive boxes.

Mr. Ravenel: In the second spawning how many boxes were there?

Mr. Beeman: In the second spawning there were I think eight boxes, and five were productive.

Mr. Ravenel: How was it with the third spawning?

Mr. Beeman: The second spawning was much smaller than the first, very few eggs deposited compared with the first spawning. In the third spawning eight boxes were spawned in, six almost at one time. After three days' duration one male deserted its nest and went immediately to another nest near by, made up his nest and selected a female and she spawned again in that nest. The next day another male deserted his nest and went to another box and spawned there with another female, but at the end of three days' time, after the eggs were deposited, all of the males deserted their nests and the third spawning was a total loss.

Mr. Ravenel: You had a total of twenty-four nests occupied during the three spawnings?

Mr. Beeman: Yes, sir.

Mr. Lydell: I think this second and third spawning is interesting. In the first spawning I have known of two males using one female. Professor Reighard and myself this year watched the fish. A pair of bass was in a bed spawning and we watched them. He got half through, got a nice lot of eggs, and another male came in and he had a scrap with the gentleman and took the female away from him and took her to another nest and spawned with her there. There were two nests of eggs from one female.

In our experimental station near Grand Rapids when we first started, our superintendent sent me there, and we had in that pond thirty-eight or forty fish, and there were nineteen nests made that were productive, and I cleaned them up, shipped the eggs and took up my apparatus and went to Detroit, and about a week after that Superintendent Bower ordered me back to the station, saying that the bass were spawning again, and I got nineteen more nests that were productive, and shipped those.

Mr. Leary: I wrote Mr. Ravenel that I had bass that spawned twice and he said that it could not be possible. I told him it was possible because I had a blind bass among the fish, and she was the only one I had that was blind, and I know that bass spawned twice.

Mr. Titcomb: Was that a female or a male?

Mr. Waterhouse: Was the fry blind? (Laughter).

Mr. Leary: I cannot tell the difference positively.

Mr. Ravenel: The reason I made the inquiry from Mr. Beeman was because the question has been discussed a great deal and it is believed that they spawned twice. Except the case referred to by Mr. Leary, which I regard as authentic, we never have had any definite proof that bass spawned twice. I wanted to prove whether he had a sufficient number of nests at different periods to indicate that the bass had actually spawned more than once.

Mr. Lydell: I know the male bass will spawn twice. I think the blind bass the gentleman speaks of was excusable, for he could not see what he was doing anyhow. (Laughter).

Secretary: I would like to ask Mr. Beeman how many fry he has planted and how many fingerlings, and how many he has on hand.

Mr. Beeman: I planted all of the fry produced there except about 16,000, as near as I could estimate it, which were put into the nursery ponds. About two weeks ago I took from those nursery ponds about 6,000 of the fish there, then an inch and a half long, and planted them in the lake. I did this to reduce the number, because I was unable to get crustacea enough to feed them at that time so that they would thrive. I have about 10,000 there at the present time.

Secretary: These are small-mouth bass?

Mr. Beeman: Yes, they are all small-mouth bass.

Secretary: Then you have had considerable success in raising small-mouth bass?

Mr. Beeman: It would seem so thus far.

Mr. Lydell: What is the source of your water supply?

Mr. Beeman: At present from our mill-dam 1,700 feet from Lake Waramoug. The original design was to get our supply from the lake far enough from the shore to avoid disturbances, but the lake was so high last fall we could not accomplish it. So we stopped our pipe about half way to the lake in our mill-dam, which takes its supply of water directly from the lake; so that we are practically getting the same water we would get from the lake, except we get some roily disturbances in time of storm.

Mr. Lydell: What designs of beds are you using?

Mr. Beeman: Acting on the suggestion in Mr. Lydell's paper read at Put-inBay, I am using a nest box enclosed on three sides. Near the surface and extending down about four inches is an opening all around this box which is enclosed with fine wire netting, which gives a little circulation of water through the top of the box. The fourth or open side is so arranged that I can slide a screen in there. When the fry are ready to arise I slip this screen in place and corral them right in this box. The only objection I have found to the box is that the water is liable to become stagnant or get a little thick there.

Mr. Lydell: Did the fish show the result of the stagnant water?

Mr. Beeman: They did. The fish began to suffer a little, coming to the surface and gasping.

Mr. Lydell: Were they suffering from hunger or stagnant water?

Mr. Beeman: I should judge from the closeness of the water in the box, for the reason that after bailing from the outside several pails full of water which when poured into the box cleared up the water, they were all right, and showed no signs of distress.

Mr. Lydell: You ought to have that little stream from Mill Creek running into these boxes. (Laughter).

Mr. Clark: I would like to ask if your screen was all around this box, why you did not keep the screen clean, then you will have your circulation of water all right.

Mr. Beeman: I used the common wire mosquito netting for a screen, and yet the little bass would go through it; it is not fine enough, and the moment I cleaned up the screen some of the bass would escape.

Mr. Nevin: Cheesecloth will answer the purpose.

Mr. Beeman: I used that on the front. An improvement suggested itself to me in this manner. On the side opposite the open side I would suggest someone try leaving an opening there of a foot in width extending from the top to the bottom of the box, or down to the gravel, and during the time that the eggs are deposited and the parent fish caring for them, I would slide a board in that place instead of a screen, and just before the fry rise I would remove the board and put in a screen there. Also the screen in front of the box. This would give a little circulation of water through the box.

Mr. Clark: That is a good idea, but I cannot conceive why your wire around here, being put there for the purpose of giving you a circulation of water, should not be kept clean.

Mr. Beeman: That would be all right if the wire netting is fine enough. Another point: this wire was placed from the surface of water down about four inches. The rest of the way down it was enclosed with boards perfectly tight. So, while the water might circulate a little at the top of the box it remained somewhat stagnant at the bottom.

Mr. Nevins: Put your wire netting down within a foot of the bottom.

Mr. Beeman: The idea in constructing a box on three sides is, to give the fish ample protection, and furthermore to handle the fry after they rise, because the school quickly scatter and it is hard to capture them. So that you have got it in a nutshell; if you have the boxes so that you can screen them in. You have only to supply a perfect circulation; I accomplished that by dipping a little water from outside and pouring it in, and it worked all right. If you intend to breed the small-mouth bass I suggest that you have on your spawning shoals even depth of two feet, because if you build these boxes perhaps two feet seven or eight inches high, they may not hold your fry when they rise. The top of these boxes must project above the water, otherwise the fry will come right over the top.

Secretary: This discussion it seems to me has a great deal of interest, because Mr. Beeman is purely an amateur who took up this matter quite recently. He resides on Lake Waramoug, Conn., from which bass were nearly exhausted, and he and others living on the lake wanted to restore the supply, and they started in in an amateur way to raise bass, and he got his information through the men of this Society who have experimented in this line. I think he corresponded with Mr. Lydell, Mr. Titcomb, and different men of the Society whose names he gathered from the reports of our proceedings; and therefore he is an amateur and goes into the work without any prejudices or preconceived opinions; and I think his experience and his opinions are very refreshing on that account, because he has not made a lot of mistakes heretofore. What he makes now he is free and frank to acknowledge, and he may have discovered something, and I rather think that he has succeeded in raising small-mouth bass in quantities which it has been stated is an almost unknown thing as yet. I believe Mr. Lydell has said that the raising of small-mouth bass has not been very successful.

Mr. Lydell: Not so bad as that. (Laughter).

Mr. Beeman: I would like to acknowledge my indebtedness to Mr. Seymour Bower of Michigan who gave me valuable information as regards the construction of the pond, and also to Mr. Lydell, but at that time Mr. Bower did not give me very much information on how to handle the bass. He said that there was little known on the subject.

Mr. Bower: You will remember you agreed to visit our Mill Creek station last season, and I said I would give you all the information I could, but you did not show up. (Laughter).

Mr. Beeman: The reason is that I was too busy at home with our own hatchery. We commenced the work a year ago this last spring and did not complete the ponds entirely; but we got them far enough along so that we collected our bass and wintered them in the ponds. They were caught with the hook and line in the different lakes last fall, with the exception of ten that I took through the ice early in March. In the spring following there was a lot of unfinished work to do, and I began at it immediately, as soon as the season would allow me to do so, we finished up the work around the pond on a Saturday night, and just about daylight on Sunday morning the bass began to spawn, so you see we did not lose very much time.

In addition to the work of constructing the ponds I have had to make all the paraphernalia in connection with it myself, and tend to the fish. Up to the present time I have done all of this with only the assistance for the last two weeks of my son, since the bass began to spawn.

Mr. Lydell: I will bet you did not work over eight hours a day.

Mr. Beeman: While I handled this vast amount of fry my work has averaged fourteen to twenty-one hours a day. In the first hatching and transferring I was obliged to use cheesecloth to strain the water at outlet of tank, and in collecting the crustacea I got some sediment in the water which clogged the screens, and I found that the tank would overflow every two or three hours, and I was obliged to stay up all night and watch the tank. But the idea suggested itself to me after losing two or three nights sleep, of using a screen of very fine wire cloth, and feeding my fry through the day with crustacea, and just at the close of the work I slipped in the wire screens and shut down a part of the water supply. I was running a supply from a two-inch pipe with a fall of fifteen inches, and the fry would drift up against the screen during the night, and this current of water was sufficient to draw them from the bottom up against the screens; but by closing down one-half of the supply, the current was regulated, so that I did not have any further trouble, and I put in the wirecloth screens and went to bed.

Mr. Clark: What is the depth of your tank?

Mr. Beeman: The tank itself is about three feet deep, and contains two and one-half feet of water.

Mr. Clark: What is its width?

Mr. Beeman: Its width is six feet and length sixteen inches.

Mr. Clark: And did you have a screen right straight across it?

Mr. Beeman: No, in two divisions on the lower end.

Mr. Clark: Did you have just a straight plain screen too?

Mr. Beeman: I had a frame in the wall: The tank was constructed of cement and stone. I had a frame in the wall about twenty inches square, and two screen frames on the six foot end of the tank.

Mr. Clark: I will show you how to build a screen that wont clog up unless your water is roily.

Mr. Beeman: This wire answered the purpose all right.

General Bryant: What was the entire length of time of the spawning season from the first to the last spawning?

Mr. Beeman: I attempted to look that up, but my memoranda are not very clear. In the first spawning the eggs were deposited May 10th, and those three spawnings occupied a period of seven weeks. It was my intention and desire not to say anything before the meeting at this time, but I was drawn into it. I intended to make a very close observation of the habits of the bass another year, get down some fine points, and perhaps write a paper then on the subject, get all this data together, and sift out the worthless and get in the valuable.

Mr. Titcomb: We hope you will do that.

Mr. Beeman: There is one interesting thing that I would like to investigate, and that is the development of the egg. We lost a lot of our eggs this year, and the only reason I can assign for it is the low temperature. The water fell to 59°. Will that temperature kill bass eggs?

Mr. Lydell: I have had 58° kill them—they died anyhow.

Mr. Beeman: One of the investigations I wish to pursue next summer is to take one nest of eggs and with a microscope make an examination of them as soon as they are deposited, to see if I can discover the germ, and how it appears when the egg is first impregnated. Possibly an observation of once a day until the eggs are hatched would give one a pretty clear idea of how a fertile egg appeared, and by examining a nest that failed you might get some idea of how you lost the eggs.

Mr. Titcomb: You can tell when your eggs are eyed.

Mr. Beeman: The bass all deserted the nests within three days' time after the eggs were deposited. Now the question is, were the eggs fertile, or had they never been fertilized. I made some examination with a microscope of some just deposited, some two days old, some three days old, but I failed to discover any germs in them, although the size of the egg makes it difficult to get a clear vision of it through a powerful microscope.

Mr. Nevin: Did your bass hatch in six days in a temperature of 60°?

Mr. Beeman: No, between four and five days, and not in a temperature of 60°; they did not spawn until 64°, and at the time the bass hatched the temperature was nearly 70°, it was beautiful weather, clear every day, and I could observe everything that took place through two of the spawning periods.

Mr. Seymour Bower: I do not want to discourage Mr. Beeman or anybody else engaged in the propagation of small-mouth bass, but speaking of raising bass from the standpoint of an amateur leads me to say this, that some six or seven years ago when we started out in the Fish Commission purely as amateurs, we had the best success in proportion to the number of adult fish in our stock ponds that we have ever had, and it was almost wholly guesswork. It was probably pure luck—I do not know what else to call it. Since then we have not had as large a proportion of beds that were productive in any one season—of course we have hatched a great many more bass, but in proportion to the number of fish, stock fish, we have never equaled our first season.

To determine whether the eggs are fertilized or unfertilized this present season we have employed Professor Reighard at our Mill Creek bass station; he is recognized as one of the most eminent zoologists in this country, and he has been there ever since the beginning of the spawning season, and is there at the present time. I asked him how he accounted for it that so many beds were non-productive, and whether he considered the eggs were fertilized or not, and he said, so far as he has been able to determine, that the eggs were fertilized, and that he could not account for the fact of their not hatching in any other way, except that there was a lack of vitality, either in the parent fish or in the eggs themselves. There was not sufficient vitality to carry them through to the hatching point, but so far as he had examined the spawn, and he had examined a great many eggs from non-productive beds, he had found them all fertilized, and I thing Professor Reighard would not make that statement unless he was certain of it, because my experience is that scientists are very careful about making any statements that they may have later to take back.

Mr. Beeman: It occurred to me that there were three conditions, as you say, that might cause failure, first, bad weather, and second, low temperature of the water, and third, that in the third spawning the bass lose some of their vitality. If there had been a continuance of the nice weather and the second hatching had produced well and the third failed, you might suppose that it was owing to the reduced condition of the fish, through long continued spawning efforts.

Mr. Bower: Speaking about the bass spawning twice, I do not think the point is established that the female will spawn at two different intervals. I think it is settled that the male bass will officiate on several occasions; in fact he is almost human in that respect, I guess (laughter), but in the single case that Mr. Leary speaks of, of the blind female, I would like to ask him how long the spawning intervals were.

Mr. Leary: It was several weeks. She spawned on the same nest, but it was after the first spawning was hatched entirely and carried over.

Mr. Bower: Are you sure the blind fish was a female fish?

Mr. Leary: I am almost positive.

Mr. Bower: It seems to me that is quite impossible—in fact we know that the female bass will sometimes spawn on two nests, but the one spawning follows the other almost immediately.

Mr. Beeman: I have noticed it on several occasions during that season and since then.

Mr. Bower: Mr. Beeman speaks of the second and third spawning; I want to inquire whether he refers to the male or female fish or both?

Mr. Beeman: The females I was not able to identify so readily as I was the males. Some of the males I had marked, and of course I was able to identify them every time. These males all cleared up their nests three different times, and two of them for the fourth time. But what led me to think that it was possible for the female bass to spawn more than once was from a little discovery I made on a dead bass. One morning I found a dead bass in the pond—the only case of dead fish I had seen since the original stock had been put in there, and I was anxious to know if I could identify the male or female by outside appearance. This fish appeared to be plump, and I decided in my mind it was a female, but to be sure I opened her. She had eggs in her, it was a female, and close examination of those eggs disclosed that perhaps one-half of them was pretty fully developed, another portion not so much developed, and still another portion a little more retarded. Now, if that should be the case when a bass first spawns, there might be a portion of her eggs ripe and ready to spawn and it might require a little period for the second batch to ripen, and likewise with the third batch.

Mr. Titcomb: I think Mr. Beeman's experience with the polygamous habits of another species there would perhaps confirm some of the observations about the habits of the bass. (Laughter).

Mr. Beeman: If the Society desire it I will take pleasure in giving an account of the incident referred to, regarding the common roach or sunfish. While I was gathering the crustacea for the small-mouth bass, my nets were placed in our mill-dam just back from the overflow where I got the right current of water. In passing out on this dam right at the crossing, a roach came up there and cleared up his bed the same as the bass; cleared off the sand and dirt, leaving the gravel in the center of the nest the same as bass do in their wild state. The first female to enter the nest was the little roach that you would suppose too small to spawn, she was in the act of spawning. This bed was so placed that I was able to get very close to it; they did not seem to mind my presence at all; I was able to observe the operation very closely; I threw a plank across from the corner of the wall, running at right angles with the dam, got out on the plank, and my face was within a foot of the fish. This little female was depositing her spawn there; perhaps she continued a space of two or three minutes. While I was watching her, another female of a larger size came into the nest; I could see plainly her sides very much distended with spawn; the male undertook to drive this second female out of the nest, but she persisted in her efforts to stay there; she overcame his efforts to drive her out, and finally he turned on the little one which had been spawning and drove her out, and immediately began to give his attention to the second female. This continued on for a time and to my surprise a third female larger than either of the other two came into the nest. After the male had gone through the same tactics as before, that is, attempting to drive this intruder out, the female that was at that time spawning with him was driven out, and the third female began to spawn in that nest. After a time the little female No. 1 roach came back again, and the larger one left and the small one began again to deposit her eggs. After a time No. 2 came back, driving out No. 1, and No. 3 female came back in turn. As my time could not be devoted entirely to observing the whole rigmarole, and I had seen enough to satisfy me that there were some things in nature that we do not quite understand, I left and went about my work; but of course I was passing back and forth often and every time I passed I observed the operation which was continued for about four hours, that is, spawning with one another of the females. During the spawning time I was so close to the nest that I could see the eggs when they were discharged from the female; they were discharged right against and directly underneath the vent of the male, the male remaining perfectly upright and the female turned at right angles to the male. They were driven out with force enough to impel them four or five inches into the water beyond, and then they settled on the gravel. I could not tell how many eggs were deposited. Each time the female turned on her side there appeared to be a muscular contraction of the abdomen which drove the eggs out with quite a little force; but as near as I could judge there were about fifty discharged each time when she turned on her side.

Mr. Titcomb: What was the effect on the male?

Mr. Beeman: At noon the male was pretty well exhausted—he was trying to fan the eggs. (Great laughter).

The eggs hatched on the fourth day. At this time the male began to take in its mouth sand from just outside of the nest, dropping it right on the fry. This he contined to do until the newly hatched fry were completely covered. Then he immediately began to make a new nest just at one side of the buried fry. When the new nest was ready, the females came in and spawned a second time. The male then gave his attention to their eggs, driving away intruders. In due time the buried fry came up out of the sand and started out in life on their own hook, while the male remained on duty.

Secretary: Since the meeting at Woods Hole, Mr. Beeman writes as follows regarding the subject of bass spawning:

"Since my return from the meeting of the American Fisheries Society at Woods Hole, Mass., I have taken time to look over my memoranda of what took place at our hatchery during the spawning season. I find that the three spawning periods extended over a period of seven weeks. The first eggs were deposited on May 10th, and the last nest was deserted on June 28th. The third spawning was a total loss. Water temperature at the time fell to 59°, and may have been responsible for the loss. Had this last spawning hatched the period would have been extended some two weeks, had the fry fully developed. There were twenty-four breeding bass in ponds, eight of which were males. One was a small bass of about one-half pound which did not select a nest or spawn so far as I am able to discover, so I am uncertain as regards its sex.

"This would leave fifteen females, which gave twenty-eight separate deposits of spawn during the three spawning periods. As I am unable to identify all of the females I cannot say positively that they all spawned even once, but from the fact that there was twenty-eight separate deposits of eggs during the three periods, it clearly shows that the greater part of the females spawned at least twice.

"As I was able to identify some of the males, I find that two of them actually gave their attention to five females each during the spawning period of forty-nine days.

"Another peculiar and interesting thing in connection with the spawning habits of the small-mouth black bass was observed during the first spawning period. On May 11th two males had selected boxes Nos. 2 and 3, and were each giving their attention to a female in their respective boxes. Male in box No. 2 about two and one-half pounds. His mate about same weight. Male in box No.

3 about three-fourths pound. His mate four pounds. In due time both females deposited their eggs, and when I left the hatchery for the night, both males were fanning the eggs in their respective boxes. Early next morning found male in box No. 2 had apparently driven off small male in box No. 3, and was giving his attention to both boxes. These boxes were about forty feet apart. For two days this male could be seen going back and forth fanning the eggs in the two boxes, remaining in each box for two or three minutes. About this time, the small bass of uncertain sex, which I have before referred to, found that while male No. 2 was fanning eggs in that box, that box No. 3 was without protection, so he immediately began to devour the eggs there. When male No. 2 returned to box No. 3, he immediately drove off the intruder. Then entering the box would fan eggs. Then a short time after he would return to box No. 2 again. During this interval the robber bass would enter box No. 3 and continue his destructive work, until again driven out by the return of male from box No. 2.

"During the day the robber devoured all of the spawn in box No. 3. After this, male in box No. 2 gave his entire attention to his own box and gave us a fine school of fry.

"My conclusions were that all of the males should be as near of a size as possible. Then no one would be able to drive off another and take possession of his nest."

BAIRD MEMORIAL EXERCISES.

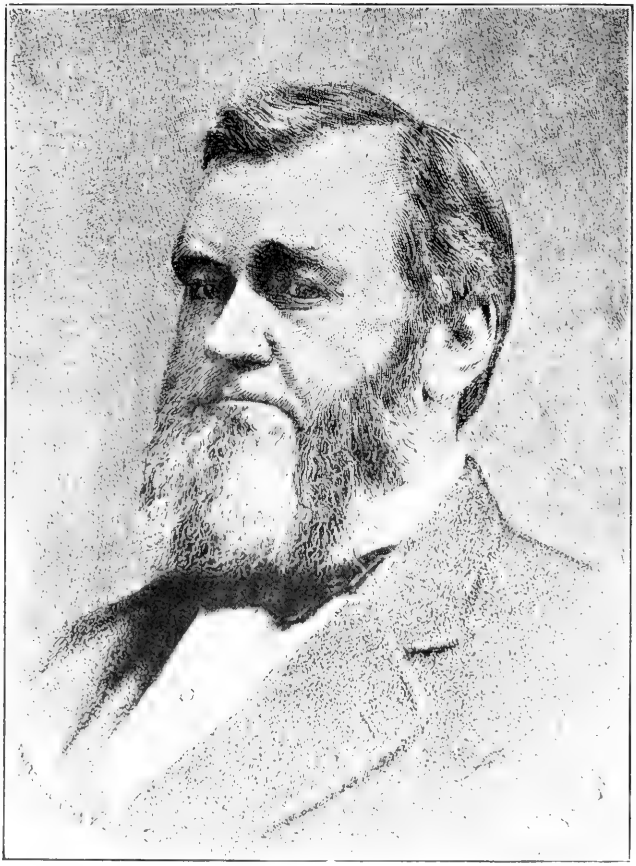
The American Fisheries Society meeting was called to order July 22nd, 1903, at 2:30 p. m., on the grounds of the United States Fish Commission at Woods Hole, Mass., for the purpose of conducting memorial exercises in honor of Spencer Fullerton Baird.

The meeting was called to order by the President, who spoke as follows:

At a meeting of the American Fisheries Society a resolution was passed suggesting the erection of a tablet to the memory of Prof. Spencer F. Baird, an appropriate tribute and recognition of his distinguished labors in behalf of fish and fisheries and biological science. A committee was appointed to raise the necessary funds, and as that committee has faithfully performed its duty we are here today to dedicate this memorial. It is certainly especially fitting that such a tablet should be erected at Woods Hole, the scene of so many of his scientific achievements, and where his life's labors ended.

The Rev. Mr. Fisher offered the following prayer:

Almighty God, the giver of every good and perfect gift, we are gathered here today to do honor to the memory of thy servant who was instrumental in founding this institution. With sincere and humble gratitude to Thee we call to mind the noble gifts of mind and heart with which he was endowed. We thank Thee for his love of science and for his illustrious labors for the advancement of human knowledge. We return thanks for the simplicity and gentleness and loveliness of his character, for the nobility of his purpose in life, and above all for his christian faith. We pray that the remembrance of his devotion to his profession, and his holy and pure example may inspire us with a like devotion to truth and a like desire and purpose to lead the way among our fellowmen to a higher and more complete understanding of the revelation of Thy thoughts and purposes in the world of nature. Help us to be imitators of that which is good so that through our lives he, who is dead, may yet speak to the world. Grant this our Heavenly Father through Thine only Son, Jesus Christ. And now in the exercises before us we ask Thee to direct us in all our doings with Thy most gracious favor,



SPENCER FULLERTON BAIRD.

and to favor us with Thy continual love, that in all that we do we may glorify Thy holy name for Jesus Christ our Lord.

President: The tablet will now be unveiled by Miss Rose McDonald, Miss Eleanor Bowers and Mr. Vinol N. Edwards.

The tablet presented by the Society was then unveiled.

The President then read the inscription on the tablet, as follows:

"In Memory of Spencer Fullerton Baird, United States Commissioner of Fisheries, 1871-1887. The American Fisheries

Society places this tablet in appreciation of his inestimable services to ichthyology, pisciculture and the fisheries. 1902."

President: It gives me pleasure to present to you Mr. E. W. Blatchford, who has been selected to deliver one of the addresses on this occasion.

Memorial Address at the unveiling of the Tablet erected to the memory of Professor Spencer Fullerton Baird, by E. W. Blatchford, LL. D. Woods Hole, Mass., July 22, 1903.

Mr. President, and Members of the United States Commission of Fish and Fisheries, and of the American Fisheries Society, Faculty and Students of the Marine Biological Laboratory.

Ladies and Gentlemen: It is three years since I had the honor of urging upon the American Fisheries Society, in response to resolutions presented by Dr. Smith, the erection of a monument to the memory of Professor Baird, and the appropriateness that such memorial should be located here, the scene of much of his most successful and distinguished scientific labor. The proposition met with an enthusiastic response, both from your society and afterwards from the United States Commission, which promptly assigned this most eligible point. A committee in charge of the work was appointed by the society with Dr. Hugh M. Smith as chairman. Under his thoughtful and efficient direction the plans were perfected, a granite boulder of worthy dimensions was found on the adjacent island of Nonnamesset, was brought and placed in position, and a commemorative tablet of bronze was designed and executed. To unveil this tablet do we meet here at this hour. Your committee would express their regret that the prosecution of important scientific investigations by the Government in the western Pacific Ocean prevents the presence with us of our honored chairman, Dr. Smith. He sends me his regrets that he cannot unite with us on this day, which was, on his suggestion, postponed a year that we might have with us the members of the American Fisheries Society.

It is due to this audience, as it is to myself, that I state that a friendship with Professor Baird of some thirty years was the argument that induced me to take part in these exercises. The time allotted will admit of but a slight sketch of some of this valuable life. For data in its preparation I am indebted largely to the memorial tribute of his esteemed friends and associate, George Browne Goode, and to other sources as well.

"Spencer Fullerton Baird was born in Reading, Pennsylvania, February 3, 1823. His ancestry on the one side was English, upon the other Scotch and German. His great grandfather on the mother's side was the Reverend Elihu Spencer, of Trenton, New Jersey, one of the war preachers of the Revolution, whose patriotic eloquence was so influential that a price was set on his head by the British government. His father, Samuel Baird, who died when his son was ten years old, was a lawyer, a man of fine culture, a strong thinker, a close observer, and a lover of nature and of out-of-door pursuits. His traits were inherited by his children, but especially by his sons Spencer and William. The early education of Spencer was obtained at a Quaker boarding school at Port Deposit, Maryland, and at the Reading grammar school. In 1836 he entered Dickinson College, and was graduated at the age of seventeen. After leaving college, his time for several years was devoted to studies in general natural history, to long pedestrian excursions for the purpose of observing animals and plants and collecting specimens, and to the organization of a private cabinet of natural history, which a few years later became the nucleus of the museum of the Smithsonian Institution. The inheritance of a love of nature and a taste for scientific classification, the companionship of a brother similarly gifted, tended to the development of the young naturalist, and a still more important element was the encouragement of a judicious mother by whom he was permitted to devote the five years immediately following his graduation to his own plans instead of being pushed at once into a profession. In 1841, at the age of eighteen, we find him making an ornithological excursion through the mountains of Pennsylvania, walking 400 miles in twenty-one days, the last 60 miles between daylight and rest. The following year he walked more than 2,200 miles. His fine physique and consequent capacity for work were doubtless due in part to his outdoor life during these years.

"During this period he published a number of original papers on natural history. He also read medicine with a physician, attending a winter course of lectures at the College of Physicians and Surgeons in New York in 1842." His medical course was never formally completed, although in 1848 he received the degree of M. D., *honoris causa*, from the Philadelphia Medical College. In 1845 he was chosen "professor of natural history" in Dickinson College, which I find included the strange combination of "teaching the seniors in physiology, the sophomores in geometry, and the fresmen in zoology." His summers, however, were devoted to extended collecting expeditions—to the Adirondacks in 1847, to Ohio in 1848 to collect, in company with Dr. Kirtland, from the original localities of the types, the fishes described by him in his work on the fishes of Ohio, to the mountains of Virginia in 1849, and to Lakes Champlain and Ontario in 1850. I may say that at that very time Dr. Kirtland discovered on the bank of the great lakes the bird which has since borne his name. In 1848 he declined a call to the professorship of natural science in the University of Vermont. In 1849 he undertook his first extensive literary work, translating and editing the text for the "Iconographic Encyclopedia," an English version of Heck's *Bilder-Atlas* published in connection with Brockhaus' *Conversations-Lexikon*.

A large field now opened before Professor Baird. On the urgent recommendation of the late George P. Marsh he was elected an officer of the Smithsonian, and on July 5, 1850, he accepted the position of assistant secretary of this institution, and on October 3, at the age of twenty-seven years, he entered upon his life work, pursued with indefatigable earnestness in connection with that beneficent national foundation. Its aim, as well as the key to the consecrated life of Professor Baird, is found in the motto of the institution and of its generous founder, James Smithson, *"The increase and diffusion of useful knowledge among men."* One evening I was sitting with Professor Baird before an open fire in his private library at Washington, and said, "A friend in Chicago has had a motto placed over his library mantel and I would like to see one over yours." "What is it?" he quickly asked, and I suggested "as typical of your own life work"—"The increase and diffusion of useful knowledge among men." He brought with him to Washington methods of work developed in his own personal experience, which became at once the methods of the establishment." His scientific enterprise, however, was not unknown to the Smithsonian authorities, for we find that "the first grant made by the institution for scientific exploration and field research was in 1848 to Spencer F. Baird, of Carlisle, for the exploration of the bone caves and the local natural history of southeastern Pennsylvania." The thorough preparation and influential position in the world of science with which he entered upon these duties is evidenced by the friendships and partnerships he had during these early years already formed with leading naturalists on both continents, and the system of exchanges which in connection with his private enterprises he had developed with European and American correspondents.

I have spoken of his connection with the eminent Dr. Kirtland in 1848. Ten years before that he had met Audobon and had felt the stimulus of his friendship, proved by Audobon's gift to his young friend in 1842 of the greater part of his collection of birds, and most of his types of new species. It was a keen disappointment to both that the illness of Baird prevented his accompanying Audobon as his secretary on his six months' trip to the Yellowstone Park in 1840. The early correspondence with such men as George N. Lawrence in 1841; with Cassin and John G. Morris in 1843, and with Brewer, and Haldeman in 1845 influenced Baird's after life. In 1847 he met Agassiz just arrived from Switzerland in company with Desor and Girard. How natural was the sympathy immediately developed between these congenial spirits is shown by the fact that within a year was projected the work of Agassiz and Baird on "The Freshwater Fishes of the United States." "In 1843 he translated Ehrenberg's 'Corals of the Red Sea' for Prof. J. D. Dana, then preparing his reports for the United States exploring expedition, and in 1846 we find him in Boston consulting the libraries of Amos Binney and the Boston Society of Natural Sciences for preparing a "Synonymy of North American Birds."

Before this audience I need not dwell upon the signal influence of Professor Baird in the encouragement of scientific enterprise from the time of his entering upon his official connection with the Smithsonian. The Department of Explorations from the start was under his charge. What that meant of laborious but euthusiastic work in organization of the extensive government expeditions, selecting commanders, nominating collectors, employing artists, and often editing the zoological portions of the reports, with the immense home and foreign correspondence involved, can only be estimated by an examination of the voluminous and systematic records of the institution.

Thus have I gathered what seems a very meager sketch of the development of the life of Professor Baird up to the time when in 1874 the office of Commissioner of Fish and Fisheries was established, to which office he promptly received the appointment. And what a wealth of knowledge, study, observation, administrative ability he brought to this most attractive field of research and public utility. There is no need that time be given here to detail the work of the United States Fish Commission. With its three-fold object you are familiar—first, the systematic investigation of the waters of the United States and the biological and physical problems which they present; second, "the investigation of the methods of fisheries, and the statistics of production and commerce of fishery products; and third, the introduction and multiplication of useful food fishes throughout the country." This annual gathering bespeaks the intelligent interest which from all portions of our country centers in this beneficent work.

It remains that I briefly sketch a few traits of the noble man who organized this work and in whose memory we are met at this hour. Though these have been often dwelt upon by those in intimate official connection with him, the occasion demands a few reminiscences, in which you will pardon some allusions of a personal character.

It was in connection with the organization and administration of the Chicago Academy of Sciences about 1868 that my acquaintance with Professor Baird first began. I had become interested in him through his papers on birds, but still more through my friend, his eminent predecessor in the Smithsonian, Professor Henry; and also through the glowing enconiums of Professor Agassiz, both of whom had visited our city. The first impression made when I came in contact with him was of a man of indefatigable activity of body and mind. This impression was correct, and subsequent acquaintance, whether in the Smithsonian, or in his own home in Washington, or in his summer quarters at Woods Hole, when surely recreation should have been secured, corroborated that first estimate. What a proof of tireless devotion is given n the bibliography of his publications prepared by Dr. Goode, issued in 1883. This list embraces 1,063 titles, of which 73 relate to mammals, 80 to birds, 43 to reptiles, 431 to fishes, 61 to invertebrates, 16 to plants, 88 to geographical distribution, 46 to geology, mineralogy, and paleontology, 45 to anthropology, 31 to industry and art, and 109 to exploration and travel. I know of no such evidence of tireless devotion in existence, where you consider the number of the contributions, the breadth of research involved, the thoroughness of treatment, and also take account of the constant burdens carried by the writer in administration of three great organizations—the Smithsonian Institution, its ward, the National Museum, and the Fish Commission. And to such a life did the world bear abundant testimony. Almost every civilized country paid him honor. Honorary degrees came to him from the universities and colleges of our own land, and I know of no prominent scientific society but what claimed him in its honorary membership. All realized indebtedness due to one who was a perennial spring of enthusiasm in departments of scientific effort so varied. Mention should be made of testimonials bestowed by foreign countries. In 1875 he received the decoration of Knight of the Royal Norwegian Order of St. Olaf from the King of Norway and Sweden. In 1878 he was awarded the silver medal of the Acclimatization Society of Melbourne, and in 1879 the gold medal of the Societe d'Acclimation of France. He bore corresponding, or honorary memberships in zoological or botanical societies in London, New South Wales, Vienna, Lisbon, New Zealand, Batavia, Buda-Pesth, Cherbourg, Jena, Halle, Nuremberg, Quebec, Berlin.

"It was a touching tribute to Professor Baird's services that was received soon after his death from Yizo, the most northerly island of the Japanese Archipelago, in the form of a little volume beautifully printed upon silk, containing his portrait and the story of his character." Perhaps Germany more than any other country recognized the importance of his services to fish culture. In 1880 at the first great International Fishery Exhition held in Berlin, the magnificent silver trophy which was the first prize was awarded to him by the Emperor William. It has been stated that while Professor Baird's portrait hung over the entrance to the American section at Berlin, the Kammerherr von Behr, the president of the German Fishery Union, the most influential fishery organization in the world, never passed under it without taking off his hat in honor of the "first fish-culturist of the world," as he delighted to call him. The nomenclature of zoology contains many memorials of his connection with its history. A partial enumeration shows that over twenty-five species and one genus of fishes bear his name, and that not less than forty species have been named in his honor. These will for all time be monuments to his memory as lasting as the institutions which he founded.

To his friends who know him best and miss him most it seems pleasanter to dwell upon the recognition which his labors received than upon the labors themselves, his devotion to which so shortened his life.

Time forbids any analysis of the character of Professor Baird. Indeed the occasion, and my personal relations to him to whose memory we consecrate this hour favors no critical sentiment. I may briefly present a few characteristics which memory brings before me. And first there stands out his modesty, always impressive whether in personal contact or in his writings. Although constantly before the public he seemed never to care for public recognition. Throughout a long life given to the public service, I find but one instance where he was induced to take the platform in a public place. This occurred a few months before his death when Harvard University conferred upon him the degree of LL. D., as "an eminent promoter of science."

"No man was more easily approached than Professor Baird. His reception of young persons, especially those with an inclination to natural history, was particularly charming, at once relieving them from embarrassment and captivating them by his unassuming manners, his geniality, and frankness." I wish there were time to present instances of these traits. They irradiate through his whole life. His unfailing geniality was proverbial. These characteristics secured for him the favorable consideration of congressional committees when presenting his requests for money to be used in the expanding work of the Fish Commission or the National Museum.

May I mention one other very marked trait in Professor Baird? His aversion to personal controversy, so decided that under no circumstances could he be drawn into one, and this when as a pioneer in scientific research his views always frankly expressed called out frequent criticism. One who knew him well writes: "One of his striking characteristics was that he would never quarrel, and never have anything to do with the quarrels of others. He was always for peace."

But the earthly end of this noble life drew on. Nature could not longer endure the strain which for nigh half a century unremitting, unselfish devotion to the promotion of science had made upon mind and body. For many months before the end, Professor Baird knew that the closing shadows were gathering. The public realized it when with startled sorrow early in 1887, at his request the Regents of the Smithsonian authorized the appointment of Professors Langley and Goode as assistants. The aid came too late. In the early summer he returned to Woods Hole, vainly hoping its pure air and cool breezes might still permit some participation in his loved Fish Commission work, and this satisfaction was to some extent granted him. His life was now restricted, and with many results of his life work about him, he calmly waited the highest summons. In this period of weakness it was his pleasure, placed in a wheel-chair, to be moved around the pier, past the vessels he had built for research, and through the laboratory where many were at work in biologic investigations. For everyone he had words of good cheer, well knowing they were words of farewell. His thoughts were with his work up to the very last. On that last morning one of his most faithful assistants, one who is now honored by us all for the valuable work he is doing for the Fish Commission, called upon him, as was his daily habit, in the early morning, when Professor Baird said to him: "I wish you would set a trap off Butler's Point (indicating the exact location), I think you may secure something there." He left immediately in his boat, and went about the work. While setting the poles for attaching the net, he glanced over to the Fish Commission Building and saw that the flag had been placed at half-mast. He rapidly rowed back and found his chief lying in the present office—gone! The end came when after a brief period of unconsciousness he breathed his last on August 19, 1887. "Of all the tributes to his character none was more eloquent than one at the funeral services, which were held in the Fish Commission building. The simple burial service had been read, when the clergyman recited these words from the Sermon on the Mount: "Blessed are the merciful, for they shall obtain mercy. Blessed are the pure in heart, for they shall see God. Blessed are the peacemakers, for they shall be called the children of God."

President: The next address will be delivered by Prof. William C. Brooks of Johns Hopkins University, a warm personal friend of Prof. Baird during his last years.

Prof. Brooks said: Mr. President, and Members of the American Fisheries Society: I thank you for this opportunity to speak of the work of that great scientific investigator, Spencer Fullerton Baird. The subject is a most inspiring one, but I know I shall have your sympathy when I say that it is also an overwhelming one. The field of Prof. Baird's productive activity was so wide and so diversified that no one can venture to present it or try to present it in a comprehensive view, and even if abandoning that attempt we pick out some one of all Prof. Baird's services to science and to his country and to the world, we find then that anyone who will adequately treat one of these subordinate divisions of Prof. Baird's work, must give to it long preparation, and must also give to it peculiar fitness and training for the work.

One must be an ornithologist, and an ichthyologist, and an explorer of the deep sea, and he must have in his mind the whole history of these departments of biological science, if he is to speak of the contributions to these varied aspects of natural knowledge which we owe to his earnestness and industry and scientific insight.

One must search the records of the Smithsonian before he can venture to speak of the results of his long service to this institution as its secretary, and one must know its later history, in order to understand the permanent influence of his administration.

One must know how the collections which he brought together overflowed its crowded cellars and dimly lighted corridors, until he laid the foundation of the National Museum, and established it so firmly, and made such wise and skillful provision for its growth and improvement that it has quickly outgrown the generous limits of the home which he provided, and must soon be cared for in a still more stately and commodious building.

One must know the history of the National Academy of Sciences, to understand his part in the organization of this body of eminent men to be the advisors of our government on those affairs of state which call for the experience and technical knowledge and judgment of scientific experts.

No one who has not seen the work of the United States Fish Commission, in all its details, upon land and sea; its work of exploration in our streams and lakes, and along our sea-coast, and in the depths of ocean; its success in protecting and preserving and increasing the aquatic supply of human food; the contribution it has made to the peace of nations by protecting and defending our fisheries from international complication; its work of biological research in the laboratory and the museum—no one who has not seen and studied and reflected upon all this until he has come to understand it in all its interrelations with economics, and biology, and education and statesmanship, and intellectual development, can venture to speak of this, the greatest of Prof. Baird's creations.

Finally, no one who did not enjoy the life-long confidence and friendship of Prof. Baird can take the liberty of telling of the sweetness and grand simplicity of his nature, of his quick and lively sympathies, of the magnanimity and disinteredness and directness of thought which were shown in his every word and act. I knew him but little, and only near the end of his days, and while I was able to perceive how much these qualities, which so endeared him to all who knew him better, contributed to the success of his great undertakings, I have no right to talk of him from this personal standpoint.

You are all as familiar with his great achievements as I am. You know that he increased the efficiency of the Smithsonian Institution for the diffusion of knowledge. You know that he conceived the plan for a National Museum, and put it into execution. You know that he was one of the founders of the National Academy of Science, and that he was prominent in its councils. You know that this laboratory, is his work, and that he was the father of the Fish Commission, and that all its diversified lines of activity were clearly and definitely outlined by him and that they have become the accepted standard and model for similar undertakings, the world over.

I should have found it a pleasant task to have made some one of these great achievements the subject of this address. I should have found profit and instruction in discovering the obstacles and difficulties which Professor Baird overcame, and in studying the tact and wisdom with which he planned and executed all his undertakings. It would have been a congenial occupation to have seen and mastered all the ramifications of the activity of one of these great creations of his genius; its growth from the foundations which he laid, along the lines which he so clearly foresaw and provided for; but I regret that it has not been in my power to handle any of these topics today; for the high honor of the opportunity to speak of the work of this great naturalist and many-sided man of science, came to me, only a few days ago, far from books of reference, and means of inquiry, at a little laboratory which I had set up at a remote point, in order to complete, in a cool climate, a biological research for which I had gathered the material, in the early part of the summer, at the new laboratory of the United States Fish Commission, at Beaufort, North Carolina.

After the completion of the central station at Woods Hole, it was Prof. Baird's plan, announced many years ago, to promote the study of marine biology by the erection of laboratories at points upon our sea coast selected for their natural advantages; and I cannot too highly commend the wisdom which has led his successors to select Beaufort for the first step in the movement to give effect to his intention.

The new laboratory, which was opened last summer, is a carefully and skillfully planned and beautifully constructed building; and it is, in all things, a model and an object lesson, for I have never seen a more convenient and comfortable and attractive laboratory.

It stands alone upon a little island close to the town of Beaufort, and it is within easy reach of the fauna of the North Carolina sea-coast, in all its wonderful richness and variety and inexhaustible abundance. It is thoroughly equipped with everything that the investigator can ask, and with all the comforts that he needs to make his life a pleasant one in the southern summer.

I cannot describe to one who has not lived and worked in this laboratory the care and thought and intelligent foresight that have been shown by those who have had it in their charge to put the plans of Professor Baird into practice, and to foresee and provide for all the needs of the investigator.

I have myself spent many summers at Beaufort with scanty facilities, and under many hardships and privations, and I had come to consider them the necessary incidents of summer work in the waters of North Carolina, so that I was lost in amazement to find myself surrounded with comforts and conveniences at the new laboratory, as I reflected that the investigator who works there in future years will have no thought of Beaufort, except as a place where every advantage is to be enjoyed without any discomfort.

They will owe these good things, as I have myself owed many opportunities to Professor Baird; so, reluctant as I was to lay aside my own work when my invitation came, I felt that it was not only a privilege but a duty to leave my microscope and my embryos, and to come here today to bear witness to my own great debts to him and to remind the younger generation of naturalists how much they owe to him.

As I have not been able to refer to the publications in which the story of his great achievements is recorded I cannot enter into a specific account of any of his great works, so I must try, as well as I can, to look at them from a more general standpoint.

It is in all modesty that I undertake this task, for the life and works of a great man like Professor Baird teach many lessons to many men, telling each one only that which he is best prepared to hear and to understand. I am well aware that he who ventures to read to others the lesson of such a life may only succeed in laying bare, to some one of deeper penetration, his own inability to grasp its truest and best meaning.

Professor Baird's public life began at a time when the scientific bureaus of the government, which have grown and multiplied with such rapidity in our day, and have become so prominent, and complicated, and important, were in the air, although they had, as yet, hardly begun their existence in tangible form.

There was need for a leader and an organizer; for a man who, while well trained in some branch of science, and thus qualified to distinguish the mere pretender from the true investigator, was also endowed with the breadth of view and the catholicity of interest which fit one for generous admiration for success in other fields, and lead him to do all in his power to promote it.

A man was needed who could inspire the confidence of his colleagues and contemporaries, sympathize with and encourage the young, reconcile the rivalries and jealousies of his fellow workers; and thus bring it about that as the various scientific bureaus of the government began to be organized and equipped for their duties, they grew up in a spirit of friendly co-operation and mutual aid.

There was need for a man whose integrity and unselfishness of purpose and earnestness and simplicity of character, and clearness and directness of thought and speech and action were so evident and so universally known and esteemed, that he could command a friendly hearing from the seat of government, and gain the intelligent interest and support of congress for new and expensive plans to extend the scope and increase the efficiency of our scientific bureaus.

Professor Baird was eminently fitted for this peculiar and difficult field of usefulness. He had many able and eminent allies and fellow workers, and while he must not have all the credit for the wisdom with which the scientific work of our government was organized and co-ordinated, it is nevertheless a fact that there are few scientific bureaus which do not still exhibit the impression of his hand, while some of them are his alone.

My own acquaintance with him began in the later years of his life, at the time when he was fully occupied in developing the plans and in laying the foundations upon which such stately edifices have been reared; so I am unable to speak of his younger days; but I cannot believe that he willingly turned aside from his earlier studies of ornithology and general natural history, or that he abandoned these pursuits for the weary and vexatious work of administration without a struggle.

He perceived the needs and the opportunities of his day, and he knew his own ability to make a wise use of these opportunities, and he entered into the work which lay nearest his hand with all the enthusiasm and energy of his kindly and disinterested nature.

The institutions with which the name of Professor Baird is associated and the works to the encouragement and promotion of which his life was devoted, exhibit a three-fold purpose: to promote the progress of natural knowledge through researches in laboratories and in museums, and through explorations and discoveries, and through the reward of membership in the National Academy of Science; to diffuse and distribute it among men by means of publications and museums and exhibitions; and to advance its application to the material needs of mankind through the protection and regulation and development of the bounty of nature. We are too apt to look at these three aspects of science as three distinct and independent fields each of which may be successfully cultivated out of all relation to the others. Thoughtful scientific investigators, who ought to know better, are not always free from a feeling of superiority to those who devote themselves to its diffusion, or to its practical application; and, some, who are less thoughtful, have been heard to speak in disparaging terms of the mere popularizer, and of bread and butter science. Some of them have even been known to boast that the object of their own researches is so far removed from the possibility of practical application that it can never, by any possibility, be put to any conceivable use whatever.

I am not able to say anything about the secret reflections of those who have grown rich through the practical application of scientific discoveries, but I have an impression, that their respect for the investigator who, while he may earn his bread, has but a small share of the world's butter, is not very great, and that they do not always look upon him as one whose life has been altogether successful.

No one has ever been more free from every trace of this littleness of mind than Professor Baird. To him the promotion of science, and its diffusion, and its practical application, were not three independent ends which could be attained by different means. He was as well aware as Francis Bacon that it is only in the co-ordination of these three aims, and in the maintenance of a just and equal balance between them, that science finds its true inspiration, and its very life. It may be that the naturalist is better prepared than other men of science to perceive this. The practical application of natural history to the material needs of mankind is not, commonly, of the sort for which men pay money. It is like the rain and sunshine. It is not thought of as enriching any, because it enriches all. It is, no doubt, for this reason, that there is more mutual respect and regard and good fellowship between those who devote themselves to research and those who are occupied with its practical application in this province, than there is in other branches of science.

As Professor Baird was a naturalist, he was better fitted than most men of science for diffusing and applying natural knowledge, as well as encouraging it and contributing to its advancement; and all his undertakings bear witness to the soundness of his judgment as to the balance which should be maintained, in a bureau of our government supported by the people of our country, between these three purposes, and the way in which success in the accomplishment of each of them should be made to contribute to the sound and healthful progress of the others. This is, in my opinion, one of the most instructive lessons of his life and work, and it is nowhere more clearly illustrated than in the organization and operation of the Fish Commission. It is because of the wisdom and foresight with which the Fish Commission has been so organized and conducted as to bring this about that it has come to be looked upon, by foreign governments as a model to be studied and copied.

The purpose for which it is maintained by our citizens is the improvement of our fisheries, and it has seemed to some that deep-sea explorations and research in laboratories are no part of its duty to the public, but Professor Baird knew that progress in the expansion and improvement of the economic work would soon come to an end without the aid of the student of pure science, and that the Commission would quickly degenerate into a mere clerical routine and mechanical round of perfunctory duties without the inspiration of scientific discovery.

All men prize the fruit, but he understood that the tree will soon be barren if we visit it only at the harvest; that we must dig about it and water it, and cherish the blossoms and the green leaves, else there will soon be no fruit to be gathered.

But I have no thought of coming before you today as a champion of pure science; nor do the people of America need to be informed that it is the fountain head from which all the arts that enrich our civilization are supplied. So I ask your leave to devote the rest of my time to the examination of a criticism which has been made of the practical work of the Fish Commission—an objection which, because of its plausibility, and because of the eminence of the authority who has been its most prominent advocate, has had great weight with many of the thoughtful and reflective, and has received the endorsement of many naturalists.

You all know that Huxley believed, and took many public occasions to declare, that marine fishes like the cod and the mackerel inhabit the ocean in such innumerable multitudes, and are so prolific, that the utmost efforts of man can have no practical effect upon their numbers, because they are exposed to the ravages of so many natural enemies that the destruction caused by man is not worthy of consideration in comparison. He is therefore led to believe that efforts to maintain them in their natural abundance or to add to their numbers by artificial propagation are misdirected and useless. Respect for Huxley's experience and good sense and sound judgment has led many to think that this opinion is sound and well warranted and when we reflect that innumerable millions of young mackerel and cod are born in a state of nature for each one that can be reared artificially, and that millions are born for each one that lives through the perils of infancy and survives to maturity, there does seem to be reason for doubting whether the efforts of man to affect the supply of marine fishes by artificial means can have any effect; for man's addition to their numbers is only as a drop of water in the ocean, and the chances of survival of any young fishes that are hatched by human aid and then cast into the ocean to share the perils of those that are born naturally can only be as one in millions.

Yet, with all deference to Huxley, I venture to assert that it is he who has made a mistake, and failed to comprehend the problem of the life of marine food-fishes, and not Professor Baird and his successors, and that the burden of error is on his shoulders and not on those of the Fish Commission.

Marine food-fishes are enormously prolific because they are exposed to so many dangers and enemies. Natural selection has, in course of ages, brought about such an adjustment between the natural destruction of the individuals of each species and their birth-rate, that the number of mature individuals of the species is about equal to the resources of the natural supply of food, and remains constant on the whole, so long as the natural conditions of their life remain unchanged. But when a new disease, or a new rival, or a new enemy, which has not been provided for and guarded against by natural selection, invades their home and comes to stay, the destructive effect of this new element in their lives soon shows itself, even when its ravages are so slight, as compared with the total number of violent deaths, that it seems to be trivial and unimportant. Man is the most resistless and insatiable of destroyers. The fear of him and the dread of him is upon all the beasts of the field, and upon the birds of the air, and upon all the fishes of the sea, and upon everything that moveth upon earth, but he is not a part of that order of nature to which the birth-rate of marine animals has been adjusted. As a navigator and a sea-fisherman he is too new to have given natural selection time to have produced any compensating adjustment; and the quickness with which he invents new weapons of destruction, and improves himself in their use, far outstrips the movement of this slow process of modification; for the time he has needed to progress from the bone fish-hook and the hurdle of rushes to the steam fishing vessel is as nothing in the long history of species. It is, no doubt, true that the whole number of mackerel and cod and herring which he destroys is as nothing, when we compare it with the slaughter wrought by blue-fish and porpoises and dog-fish, and other sea-robbers, but this slaughter is provided for in the birth-rate, while that which he works is not. While a number of food-fishes greater beyond all computation than man destroys has been destroyed by natural enemies each year for ages without any effect upon their abundance, every one knows that when man turns his energy and intelligence and inventive skill to the work of destruction he quickly brings about a very notable decrease in the supply. It is because the slaughter caused by man is infinitesimal that an infinitesimal increase in the birth rate is all that is needed to make it good, and this infinitesimal increase in the birth-rate it is, fortunately, within the power of man to bring about by artificial propagation. Instead of showing that efforts to maintain sea-fisheries by artificial propagation are misdirected and useless, the well known facts to which Huxley calls our attention, turn out when carefully considered and thoroughly understood, to afford the clearest proof of the prudence and wisdom and foresight and scientific knowledge of Spencer Fullerton Baird, the founder of and father of the United States Fish Commission.

President: We have with us today two members of the American Fisheries Society who are among the early appointees of Prof. Baird, both of them, as is well known, have made splendid reputations for themselves in connection with the United States Fish Commission. It gives me pleasure to present to this audience Mr. Frank N. Clark, of Northville, Michigan, who will address you.

Mr. Clark: Mr. President and Fellow Members of the American Fisheries Society, Ladies and Gentlemen: It is with a feeling of the deepest sadness that I undertake to tell to you my feelings towards the man whom this memorial tablet represents. It is true that I was connected with Professor Baird in the early stages of the Fish Commission. My association with him was from time to time, and during a period of about fifteen years when the Fish Commission was not what it is today, when the practical men of the Fish Commission were working in all manners and ways, as you might say, to get the Fish Commission started, and none of those practical men had a warmer friend in all the work than Professor Baird. He was an inspiration to them to do all they could in helping to establish the Fish Commission. I might tell you all that I feel and all that Professor Baird did for me, but my heart is too full to express it, even had I the ability to do so. Professor Baird was an inspiration in his talk, and many a talk have I had with him on the practical side of fish culture. Discouragements would arrive, and through his talk and through his correspondence new inspiration was given. My friends, not having had time to prepare anything, as I was only spoken to to say a word in regard to this matter, I will now leave you.

President: The other gentleman I referred to a few minutes ago is Mr. Livingstone Stone, of Vermont, who will now say a few words.

Mr. Stone: Mr. President and Members of the Fisheries Society and Ladies and Gentlemen: I do not feel that I can add anything to the very able and interesting addresses which you have already heard, but at the same time I do not feel as if I could wholly decline to say anything on this occasion, for I am one of the few living early appointees of Professor Baird, who were appointed when the United States Fish Commission was started. It was my privilege to know Professor Baird from about the time the Fish Commission was inaugurated until the time of his death. It was also my privilege to be in somewhat close relations with him up to the time of his death. It is just thirty-one years ago this month, and almost thirty-one years ago this very day, that I was appointed by Professor Baird to be his deputy commissioner for the Pacific Coast, but if I should attempt to say anything at this time without preparation I should certainly not feel equal to the occasion; I should feel very far from equal to the occasion; however, just before I left home I happened to come across a copy of the Forest and Stream which had something in it which I wrote some time after Professor Baird's death, and although I think it is hardly fair or proper to inflict a printed page upon this gathering today, or upon any occasion, I feel sure that it would be much more satisfactory to you if I should read this quotation from Forest and Stream, than if I should try to make any fragmentary remarks without preparation. So with your kind permission I will read one or two extracts, but I will not take much of your time.

"The mere mention of Prof. Baird's name strikes a chord of dear memories in the hearts of all who knew him. No man of our time has left a purer memory, a more stainless name or a more animated or enduring influence over his special field of labor than Prof. Baird. He was loved by those who knew him when he was living; he is revered by those who have survived him. Prof. Baird lived in a higher plane of life and breathed a purer atmosphere than most men. Quiet and unassuming, with a nature as gentle as a child's, his natural superiority never failed to show itself when he was with other men, not even among the distinguished men who gathered in the winter at the national capital. Yet he was thoughtful and considerate of his subordinates, and always ready to give his meed of praise of any work well done by his humblest employee. Prof. Baird had the enviable gift not only of endearing everyone to him who came in contact with him, but of inspiring them with his own enthusiasm and energy. This made congressmen vote him all the appropriations that he asked for; for it was a common saying at Washington that congress gave Prof. Baird everything that he wanted. Like a good general, he had the personal welfare of his men at heart while he was Fish Commissioner, and they in turn wanted to do everything in their power for him, which doubtless, was one of the secrets of his great success.

It is a fact that his employees in the Fish Commission would voluntarily work a great deal harder for Prof. Baird than they would for themselves. This fact is accountable for another saying at Washington at that time, that Prof. Baird's men were the busiest workers of all the departments. It was the inspiration of this patient, disinterested, tireless, kind-hearted and lovable man whose work they were doing that made them work so well, and also made their work a pleasure.

It is unnecessary to say that Prof. Baird possessed extraordinary mental endowments, but I perhaps may mention one or two, as they are so rare. He had a quickness of apprehension that sometimes seemed supernatural. For instance he would glance down a printed page and comprehend in a moment what would take others several minutes to read.

He had a marvelous memory, not only retentive of everything intrusted to it, but quick to call up anything that was wanted when it was wanted—a quality which most of us know well how to appreciate. His mind was also of the clearest type. No complications ever seemed to confuse him; he never became involved during his conversation, no matter what were the intricacies of the subject. His mind, like his placid temper, never seemed to be ruffled or disturbed. Extraordinary as his mental faculties were, he had evidently added to their efficiency by severe discipline, for he possessed that infallible mark of a well-trained mind, of having all of his great and diversified stores of knowledge classified and grouped together in his brain according to subjects, so that he could call up his whole knowledge of any subject at a moment's notice. Another remarkable thing about Prof. Baird's mental composition was that with a thoughtful, scientific cast of mind were united qualities of the most practical character. Prof. Baird was a scientific man by nature. He loved science and scientific studies; but at the same time no man had a sounder judgment or a clearer head in the management of practical affairs than he did. It is very rare to see scientific and practical qualities of mind united in such an eminent degree as they were in Prof. Baird's.

Prof. Baird was gifted with still another unusual mental endowment which reminds one strongly of one of the traits of the first Napoleon. With that comprehensiveness of mind which takes in the broad features and large general outlines of a great enterprise, he combined, as Napoleon did, a capacity for close and thorough attention to all the details of a subject down to the minutest item necessary to success. This combination, as we all know, is a rare one.

Prof. Baird has been called a plain man. He was a plain man indeed, but one who was made after Nature's largest pattern of man. He was large in mental calibre, and large in physical frame; large in his broad sympathies and in his wide scope of vision; large in his comprehensive grasp of great aims, and large in his capacity for great undertakings; large in everything, but small in nothing.

President: This closes our exercises, and on behalf of the American Fisheries Society I want to thank you for your presence here this afternoon and your courteous attention.

DISCUSSION ON BASS RESUMED.

Mr. Dean: I wish to refer to one or two points on this subject. We were talking about places where bass were hatched under good natural conditions. Both stations talked about the most have an immense growth of vegetation in their ponds; and I would like to know how to produce that growth. When it does not grow naturally what cause is there for it? There is a question there I have not been able to solve so far, and on that question hinges the question of natural food largely, and also the question of producing bass. I do not believe there is any trouble about producing bass if you have the natural food and the moss, but if you do not have those you cannot get very many bass unless you put them out as fry. Is it a question of soil, water, temperature or what? Mr. Leary says he hauls his ponds down in winter and leaves them dry from six to ten weeks; Mr. Lydell says he never hauls his pond down, and both claim to have an immense crop of vegetation. Some years we have plenty and other years apparently under the same conditions there is absolutely no vegetation.

Mr. Titcomb: Do you haul your pond down?

A. Occasionally.

Q. Do you leave it bare in the winter?

A. Sometimes, not always.

Q. Does not that kill your vegetation?

Mr. Clark: What is your theory in regard to the matter?

Mr. Dean: I have had so many theories and had them upset that I do not know as I have any now.

Mr. Titcomb: Have you had this lack of vegetation on the years following that when you did not draw the pond down.

Mr. Dean: After we draw the pond down for repairs vegetation does not always come up the first season, but the next year we get a good crop nearly every time. This year, for instance, one pond was full of vegetation in the spring and we hauled it down to take out the breeders and any other fish we did not want there. We mowed the vegetation in order not to disturb the roots, and afterward filled up the pond, and it was filled up as soon as possible—I do not think it was dry a day, but the vegetation all died except a little around the inlet.

Mr. Titcomb: Don't you think the vegetation was killed in that case by hauling the pond down?

Mr. Dean: I don't know.

Mr. Riley: Did you ever try to pull it down in October?

Mr. Dean: No, in the spring, in March after the vegetation comes out; then the conferva comes in very thick and yet this pond which we call No. 14 discharged all its water in the pond below which is No. 7, and No. 7 has almost no conferva in it, yet the discharge from No. 14 which was full of conferva goes into No. 7 and does not produce any there to amount to anything.

Mr. Titcomb: Do you think March is the proper time to draw it down?

Mr. Dean: I would rather do it in February, but I could not do it then this year—I think it ought to be done a little while before the fish spawn.

General Bryant: What do you draw it down for, to secure a complete change of water?

Mr. Dean: No, sir, to arrange your spawners for the season's work, and to get out any undesirable fish that there may be in the pond.

Mr. Titcomb: It seems to me that Mr. Dean has answered his own question. He has drawn his pond down at an improper time.

Mr. Leary: Draw it down in October. As soon as your bass is distributed take your old fish, put them in a nursery pond and draw your brooding ponds down.

Mr. Dean: If we put our breeders in the pond the first of January by the first of July the pond would be so full of crawfish there could not anything grow.

Mr. Lydell: I do not see any other way for superintendents to work that out except to do so independently. Conditions differ at all different bass stations. We have no trouble at our stations as far as vegetation is concerned. We cannot draw the water all out of our ponds and there is always a foot or so in them.

Mr. Ravenel: How old are your ponds?

Mr. Lydell: Five years. The only way, as I say, is for the superintendents to work the problem out themselves according to conditions of the country. The conditions even in different parts of the same state will vary.

There was some talk this afternoon when the specimens were being distributed in regard to what was fry and what were fingerlings. I have brought some specimens here. The age is not given for some of them, and Mr. Clark, of Northville, thought that those that I called fry were pretty large for fry, and I would like to exhibit these specimens here as showing what we ship as fry and what we ship as fingerlings. Of one size which I show you here we shipped this season 636,000.

(Mr. Lydell here exhibited a specimen somewhat less than an inch in length).

Mr. Titcomb: How do you count them?

Mr. Lydell: Two thousand or whatever we ship in a can and those are estimated, and these are what we ship as fingerlings, both the large and small-mouth.

(Exhibiting the same specimen referred to).

We ship lots larger and some smaller.

President: I would like to ask Mr. Clark what he calls those?

Mr. Clark: I do not call them fry.

Mr. Lydell: Perhaps we have 15,000 more of that kind to ship. What we ought to get at is where we are going to establish the fry and where the fingerlings. We ought to determine what to call them.

Mr. Leary: In your paper of last year you described fry as those just risen from the nest, and mentioned baby fingerlings three-quarters of an inch long to an inch long.

Mr. Lydell: Those fry are the small-mouth bass, but these are the large-mouth. I did not bring any of the small-mouth fry along this year, because I had them at the society meeting last year. You are correct about the statement.

Mr. Titcomb: Those are the smallest fry you ship?

Mr. Lydell: Yes, of the large-mouth fry.

Mr. Clark: I cannot conceive of the idea of any kind of fish, whether bass, trout or what it be, being planted and called a fry when it is a full-fledged fish. Now, I have never made a business of hatching and planting bass. I have examined some little bass under the microscope, and I have taken bass even a considerable smaller than the specimens and looked at the outside of them under the microscope, and I cannot see any difference between a fish of that size and just a little smaller, and a full grown bass three or four inches long. They are the same. They are a full-fledged fish in shape. You have got the color here in the large mouth of the black striped bass, and I do not see why those fish should be called fry. Now, a trout in the condition of the specimen of course would be longer and larger—we would not call it a fry, and why should we call the specimen a fry? We call a trout fry about the time the sac is absorbed, and a little while after; but a two and a half to three months old trout we would not call a fry—it is not a fry, it is a partially grown fish. Now, that is just the case here. This is what I argued last year, that in my judgment it is just as well to plant those fish as it is to plant your two, four or six inch fish, exactly, excepting that you have protected them that much longer from their enemies—that is my idea of the fry and the fingerlings.

Mr. Lydell: I have here some large-mouth fry; but as we shipped them out that way I do not know what else you could call them. You would not call them fingerling, and therefore, we call them fry.

Secretary: Is there any difference between the large-mouth and small-mouth fry?

Mr. Lydell: We have shipped all of our small-mouth bass when they first rise from the bed, three or four days old, or else we do not ship them until they are fingerlings.

Secretary: Why should you distinguish between the two—one is a fry as long as the other.

Mr. Lydell: The large-mouth is a great deal larger than the small-mouth when shipped.

Mr. Clark: Of course Mr. Lydell would not advocate the shipment of the specimen?

Mr. Lydell: Oh no.

Mr. Clark: And you claim those are fry, as I understand it.

Mr. Lydell: Yes.

Mr. Ravenel: How much larger are your small-mouth shipped as fry than the specimen?

Mr. Lydell: About six times as large.

Mr. Seymour Bower: I think it is misleading to call these specimens fingerlings. I have called them advanced fry to distinguish them from larger or smaller fish. The term advanced fry or baby fingerlings might be used, but to call them fingerlings is misleading.

Mr. Clark: This matter of the bass fry and bass fingerling might possibly lead to as much discussion as years and years ago when hardly any of you were at the meeting, when we had the trout fingerling and fry discussion. I fought and fought and bled over that ground—I did not die—I am still here. (Laughter). Most of the rest of them, poor fellows, are dead, but I am still on earth. Now, I would suggest and if necessary make a motion, (of course you will not consider me in that motion) that a committee of three of the American Fisheries Society be appointed to settle the question of when the young bass shall be called a fry and when they shall be called fingerlings, for future definition, not only for the Fish Commission, but for all the state commissions and private hatcheries.

Mr. Seymour Bower: I do not think the committee should be confined to the terms fry and fingerling—they might wish to recommend or coin a new term for small bass midway in size between fry and fingerlings.

Mr. Clark: Certainly.

General Bryant: Have the committee establish a standard of weights and measures? (Laughter).

Mr. Lydell: Last year I called them baby fingerling in my report to the Michigan Fish Commission, and I was not satisfied with that, and so this year I just shipped them out as fry until they were fingerling.

Motion unanimously carried and Mr. F. M. Clark, Mr. Seymour Bower and W. DeC. Ravenel appointed as such committee.

Mr. Beeman: In regard to the question of fry and fingerling, our bass when they arose from the bed were black in color and they continued black until they were about an inch long; then they changed and grew lighter in color and took on the natural color of the adult. It strikes me that there would be an opportunity to draw the line, and that after they change the color and take on the color of the old fish would be the time to call them fingerlings.

Mr. Bower: That would do very well with the small-mouth, but not the large-mouth bass.

Mr. Beeman: I would confine it to that.

Mr. Lydell: It seems to me we are all satisfied in regard to the small-mouth bass, but the large-mouth is what we are trying to get at, but everybody is satisfied that bass planted at that age are nearly as good as they are when twice as long. So I do not think the matter will develop anything very serious.

Mr. Atkins: I would like to suggest that the committee be authorized to consider the question of the name yearling. As I understand, it has been the custom to call fish six or seven months old, yearlings. I have never done it myself. In order to keep out of difficulty I have always stated the age of my fish in months—six, four or two as the case might be—but I have not adopted the name fingerling, because I could not determine just what it did mean, and therefore avoided using it. It would be a convenient term, and when this committee has decided what it means I shall be glad to adopt it. I think according to the dictionary and the usage in the nomenclature of other animals, no animal is called a yearling until it is a year old, and then it is a yearling until it is two years old; and it seems to me it would be entirely proper to adopt that standard with fish.

Mr. Seymour Bower: Would the gentleman consider the beginning of the year the time the egg is laid, or the time the fish hatches?

Mr. Atkins: The time the fish hatches.

Mr. Ravenel: That question has been raised very often in connection with the preparation of the United States Fish Commission reports. The difficulty arises from the fact that some fish are spring spawners and others are fall spawners; though we do call the fry resulting from eggs taken in the spring and fall, yearlings, when distributed in the fall, it has been based on the theory that the majority of the salmonidae distributed result from eggs taken in the fall, and we estimated the year as from the time the eggs were taken to the time the fish were distributed —where they were carried an additional year they were considered as two years old. The definition, perhaps, was not accurate.

but was a basis on which to make up reports, because we did not wish to individualize the age of the fishes from each of the stations. We had to adopt the same plan in designating the yearlings or fingerlings resulting from the black, spotted or rainbows, Rocky Mountains, etc., taken in the spring.

General Bryant: You cannot keep a register of births in these cases.

Mr. Ravenel: It would be impossible in distributing a billion four hundred million fish to indicate the age of the fish.

Mr. Atkins: However, the salmonidae are nearly all of them hatched in the spring and would be a year old the next spring, and not until then.

Mr. Titcomb: In the last report the fish have been classified under one column of fingerlings and yearlings. That brings the fish from six months to a year old in the same category in regard to distribution.

Mr. Atkins: I think in no other animal is it considered the rule to reckon the age from the time of conception rather than the time of birth. (Laughter).

Mr. Ravenel: We admit that.

A FATALITY AMONG FISHES IN WATER CONTAINING AN EXCESS OF DISSOLVED AIR.

BY M. C. MARSH.

For some years the fishes in the aquarium at the Woods Hole Station of the United States Fish Commission have presented a peculiar phenomenon consisting in the presence of gas bubbles clinging about their bodies and fins. Occasionally some of them developed in the membranes of the fins, or elsewhere large blisters which contained a gas, and would collapse when punctured. Others had bulging eyes, the affection commonly called popeye. There was some mortality among these fishes, but not to a serious extent, and fresh supplies of specimens were so readily available that no serious inconvenience was caused. But during the last fall and winter the losses did become serious and the aquarium exhibit could not be maintained without a new supply every few days, and sometimes more than half the stock would die within forty-eight hours after a lot fresh from the harbor had been introduced. The cleanliness of the aquarium tanks was thorough and the sea water which was successfully supplying the cod hatching operations, was apparently the same as usual.

The species of fishes at this time common at Woods Hole were the white perch, tautog, tomcod, flat-fish, and two kinds of sculpins. When these were introduced into the aquaria this curious development of gas bubbles upon the fishes became evident within about two minutes. The individual became completely covered with extremely minute bubbles which grew slowly larger until after ten minutes they were very conspicuous and appeared to envelop the fish in a delicate silvery white coating. Some species were more completely covered than others but all without exception developed the bubbles in greater or less abundance. As the bubbles grew larger they began to be released by the movements of the fish in swimming, and passed off at the surface of the water. New bubbles formed, however, to take the place of those released, and the fish seldom remained clear of them for any length of time. If a well covered individual were taken from the water for a few seconds all the bubbles would dissipate in the air. After the return to the water the fish in a few minutes would be as well covered as before. The blisters in the skin, or on the fins, were not formed until after hours or days, and were of course more permanent, being surrounded by a thin membrane—a layer of the skin—and really within the fish itself. With some specimens the buoyant effect of the bubbles and the blisters together was plainly seen in the constant effort to swim down in order to keep below the surface. The evolution of gas bubbles was not confined to the fishes alone, but appeared upon the sides of the aquarium tanks and on nearly any mechanical surface submerged in the water.

It should be said that at other seasons, chiefly in the summer, "popeye" was common among the fishes, the scup being particularly affected. At the time of the occurrence of the mortality of the past winter the scup was not in season and the species then used in the aquaria did not exhibit popeye. While it is at least possible that this bulging of the eyes is due to the same cause as the gas symptoms here described, the popeye of the scup and other summer species is not necessarily included here. There is undoubtedly more than one kind of popeye.

These fishes soon died, after varying periods, some in a few hours, others living several days. Aside from the symptoms of gas already mentioned they showed but little external evidence of disease or injury. On opening them, however, a strange and unusual condition appeared. Gas was present in the larger blood vessels. The heart itself contained gas as well as blood, and was sometimes found with one of its chambers distended with gas to the exclusion of the blood. The vessel from the heart to the gills could be traced empty of blood, and the gill-filaments had each a plug of gas which plainly made the passage of blood impossible. In these cases the cause of death could be plainly due to suffocation. In some way gas had been liberated within the blood vessels and finally accumulated in such amounts as to entirely obstruct the circulation. The external gas already described evidently did no particular harm, but that within the blood vessels was fatal, as it is within the human vessels when present in any considerable amount.

The affection may be called a gas disease in consideration of the very plain lesions. But what is the gas, where does it come from, and how did it get free within the vessels? The first thought is of bacterial infection, for many bacteria produce gas. The microscope shows no organisms of this nature in the blood, and moreover, the blood is sterile when examined in bacteriological culture media. Bacteria do not cause the mortality. The explanation now to be offered falls somewhat short of absolute proof, but it explains so plausibly that proof of it is anticipated. The external gas is ordinary air. It does not emanate from the fishes themselves, but separates from solution in the water upon their bodies just as it does upon any other solid surface immersed in the water. This gas collected from its loose adherence to the exterior of the fishes and from the large blisters or vesicles in various parts of the skin, has been examined by the chemist and pronounced air with a slight admixture of carbon dioxide. The gas from within the vessels can not only be easily collected in amount and has not been examined chemically, but in the light of the other facts it is in every way probable that it also is merely air.

Now inasmuch as any water fit for fishes contains air in solution for their breathing purposes, and they live in it without such startling results as above described, this particular water is of extraordinary quality with regard to the air it holds in solution. The air is in excess; the water is supersaturated with it, and the excess constantly tends to escape in the form of small bubbles which gather on the fishes and other solids, and also insensibly at the surface of the water.

In order to understand how an excess of air gets in solution in the water, why it tends to pass off afterward, and how it has access to the blood of fishes, some general considerations are necessary. Water dissolves gases according to definite laws, the variable factors influencing solution being temperature and pressure. Cold water takes up more air than warm water, and under high pressure more than under low pressure. The waters of nature—the sea, lakes, rivers, brooks, etc.,—usually, but not always, take up air from their surfaces only, and at the atmospheric pressure, which is only slightly variable. Fishes in such waters are ordinarily accustomed to dissolved air, the maximum amount of which would never exceed that which the coldest water would absorb at the highest atmospheric pressure. The depths of such waters are of course under an increased pressure, which is proportional to the depth, and if air were present at these depths the water would absorb an excess of it. By excess is meant always that amount over and above what the water could hold if it were at the surface and therefore under atmospheric pressure only.

Under natural conditions water will seldom acquire an excess of air. But under certain artificial conditions the water and air may be brought together under a greatly increased pressure more than the atmospheric. In this case an excess of air will be forced into the water. The water will become supersaturated. This is what occurred at Woods Hole. The arrangement of the water supply you can yourselves examine. A steam pump takes up water from the harbor through a long suction pipe and forces it up into two reservoir tanks. It flows thence by gravity to the hatchery and aquaria. The height of these tanks is about eighteen feet and the pressure at the pump is about eight pounds made by this eighteen foot column of water. The pump was found to be forcing, not water alone, but water containing many bubbles of air which entered presumably through a leak or leaks in the suction pipe. This air does not dissolve in the water to any great extent until it passes the pump, whereupon it enters the region of increased pressure and commences to pass into solution. We may assume that the sea water when it enters the suction pipe contains all the air it will hold at the temperature which prevails and at the existing atmospheric pressure. It may fall somewhat short of this, but the point is immaterial. At any rate, it reaches the storage tanks containing too much air—invisibly present in solution. It is now exposed to the air and some of the excess may pass off, but as water is constantly passing through the tanks there is no time for this process to accomplish much. It reaches the aquaria and hatchery boxes with its considerable excess of air, and it causes upon any fishes present the symptoms already described and which finally end in death.

The processes of release of the excess of air from solution, and of its appearance within the circulation of the fishes are to be considered. The pressure being removed, air begins to leave the water spontaneously as soon as it emerges from the pipes. It passes off insensibly at the surface but it also gathers in visible bubbles on the sides of the tank and on the sides of the fishes, as already described. A solid surface excites the release of gas from a solution supersaturated with it, much as a crystal or foreign body will cause precipitation from a supersaturated solution of any readily soluble salt. The aquarium tank of water, holding many gallons, will, if the flow is cut off, lose its excess of air, but it takes a number of days; two or three gallons, in a hatchery jar, will lose it in two or three days; a teaspoonful, probably in a few minutes. If the water were warmed the escape of air would be greatly facilitated. While the aquaria contain fishes and there is a continuous flow of water, the supersaturation is constant and nearly equal to that within the pipes. The spontaneous release is so small as to be negligible as far as the fishes are concerned.

These fishes find themselves in much the same situation as a person who is subjected to a pressure of more than one atmosphere, as in a very deep mine, or as in the case of divers or workmen in caissons in bridge building. In either case the breathing apparatus has a task for which it is not adapted. The results are more disastrous with fishes than with people. The gill filaments of fishes are osmotic membranes, that is membranes which allow substances in solution (in this case particularly gases) to pass through them. The osmotic pressure is proportional to the amount of gas in solution. With this water containing an excess of air, the osmotic pressure is high, higher than the fishes experience in nature. The air passes rapidly into the blood and tends to dissolve in it to the same degree of excess in which it is present in the water. In other words, the osmotic pressures on the two sides of the gill membrane tend to equalize. The blood as it streams through the gills becomes, like the water, supersaturated with air, probably with nitrogen as well as with oxygen, although the latter only is concerned in ordinary respiration. But so far the air is still in solution and not free in the vessels. What precipitates it? Two causes tend to this result, one the presence of corpuscles, the other and probably more important being the higher temperature of the systematic circulation of the fish. While fishes are cold blooded animals, they nevertheless are slightly warmer than the surrounding water. This may be inferred from the fact of oxidation in living animals, and direct observations have corroborated it. In the thin gill filaments the blood must cool to substantially the temperature of the water. But after leaving them, oxidation occasions a slight warming. In this warmer blood gas is less soluble and some of the air must come out of solution as free bubbles. This process is continuous, and finally enough air accumulates to plug the circulation.

By subdividing the flow into very many fine streams the Woods Hole water could be deprived immediately of its excess of air and fishes would live in it without unusual symptoms. A simple apparatus, a dishpan with the bottom punched full of small holes and raised several feet above the tank it supplied to give the streams a fall, served this purpose. It is to be remarked that such an apparatus aerates water if it is lacking in dissolved air and deaerates it if it has an excess. The process tends toward a certain constant, which is the maximum amount of air the water will hold at the temperature and pressure existing.

The eggs and fry of the codfish were not affected by this water which was fatal to adult cod or adults of any species. This is a rather remarkable and interesting fact. It is true that while the eggs are in this water during almost the whole period of incubation—some two weeks—the fry are in it only a few hours or at most a few days. They are planted very soon after hatching, yet they often remain in the water for a period which would be fatal to adults, without appearing to be injured. The explanation is to be looked for in their very different organization from that of the adult. A newly hatched fry is far from being a full fledged fish in other respects than size, and we can hardly suppose it to maintain a temperature appreciably above that of the surrounding water. This would remove the chief cause which tends to release the gas once dissolved within the blood.

The general features of this mortality present three salient particulars. First, its severity. In the degree of supersaturation existing at Woods Hole it was absolutely fatal. There was no resisting the fatal outcome, no treatment or remedy while fishes were within the affected water could be of any avail. With even the hardiest and least susceptible species—the mummichog—it was merely a question of time. Secondly, the simplicity of the original cause and of the mechanical process which usually is the immediate occasion of death. Leaks in a pipe were at the bottom of the whole trouble, and the leaks introduced nothing more remarkable than air. Parasites, bacterial or otherwise, are not concerned; but purely physical causes alone, the laws of which have long been known. Thirdly, the essential and active agent, air, which alone is the immediate cause of death, is one whose lesser constituent, oxygen, is absolutely necessary to the life of fishes and of most living things. The mortality is a conspicuous example of too much of a good thing. Without entering into, partly from ignorance, the separate roles played by the oxygen and nitrogen of the air in respiration in fishes, it may be remarked that the respiratory mechanism is nicely adjusted to water containing air the amount of which is within certain limits,—on the one hand enough to barely oxidize the blood, on the other to the point of saturation. Below one limit and suffocation results; above the other limit and, strangely enough, suffocation may result also, but more indirectly, first mechanically stopping the circulation. Between these limits all fish cultural operations, with adults at least, whether of nature or by artifice, must be carried on.

It must not be supposed that nature always avoids surpassing either of these limits. It is well known that springs are apt to deliver water lacking in air,—not well aerated. On the other hand, wherever it is possible for air to accompany spring waters through any part of their course, it will pass into solution according to the depth at which their air is present. This may of course be considerable and some springs do give forth water containing an actual excess of dissolved air. The degree of excess is doubtless much less than that of the Woods Hole water. In these cases air will usually be seen to bubble intermittently from the spring bottom. As the water flows away from such a spring, the excess passes off and the water soon corrects itself.

The Woods Hole occurrence impresses upon fish culturists and managers of large aquaria the fact that where pumps supply the head for the gravity system, a danger constantly menaces. It may remain in abeyance and never do any damage. If the suction pipe is intact—quite impervious—where it is not under water, and no free air can be taken up with the water at the point of intake, all will be well. If the suction pipe is of wood, very slight breaks or a general porosity may develop as the wood decays, a condition which may not be noticed since air leaks *in* instead of water leaking *out*. The first entrance of air will probably be small in amount and make only moderate trouble with the stock of fishes, a trouble which would not readily refer itself to its real cause. Very slowly and gradually these leaks increase and the mortality becomes gradually and insidiously more serious, until the water kills all fishes soon after they are placed within it. This insidious progress has aided in obscuring the real nature of the mortality.

DISCUSSION.

Mr. Atkins: I would like to inquire whether there is any ready means of measuring the amount of air in water and ascertaining by any sort of observation, so that we can know when there is an excess.

Mr. Marsh: A chemical determination will show, but it is rather lengthy and involved. I do not know any very ready means except this. You can take two glass stoppered bottles, where the stopper fits perfectly, and fill one absolutely full of some ordinary water, and insert the stopper so that there are no bubbles whatever, letting it stand until any bubbles that may be in it are dissipated, insert the stopper so that after it is in no bubbles will be seen; then take in the same way a sample of suspected water and put them together where it is warmer, or put them in a dish of warm water and let them come up to the same temperature. Then in the case of the one that has the most air there will separate from it the greater amount of air; you can see which bubble is the larger. You can get a rough idea that way.

Mr. Atkins: Perhaps that is close enough for practical use.

Mr. Marsh: I would try it. If from such a bottle there separated no more gas than from a bottle of water I knew contained no excess, the inference could easily be drawn that there was no excess in the suspected water. If the bubbles were larger it might merely be better aerated.

General Bryant: Was this water sea water?

Mr. Marsh: Yes, sir.

General Bryant: Do the same conditions ever arise in fresh water?

Mr. Marsh: Yes, sir. If you have a mechanical plant like the one here, and were pumping fresh water, there is no reason why the fresh water would not become saturated in the same way.

General Bryant: Have you any instances of fish suffering from this condition except in salt water?

Mr. Marsh: I have no doubt that there are such instances, yes, sir.

Mr. Titcomb: I think this paper is especially valuable, and possibly the fish culturists have not all appreciated it, regarding the point I am going to bring out, and General Bryant's inquiry would naturally bring it out. Here at this station the question is easily solved by having tight suction pipes, no leakage to admit air, but it appears that springs sometimes contain an excess of air: Now, the fish culturist ordinarily in looking for a location for a hatchery for an eyeing station will examine the spring and will question whether the water contains sufficient air. It seems that we have got to guard against superabundance of air in the same way. We have in the commission one station today suffering from an excess of air coming right into the spring. The air bubbles up and rise up through the spring to the surface of the water—that is the station at Erwin, Tennessee where Mr. Jones is superintendent, and we have had serious trouble with the fry before Mr. Marsh made some investigations and solved the problem there as he has here. There we can probably arrange matters so that the water will be all right in the hatchery by the same treatment that we would give water which lacked air—aerate the water by passing it over a series of falls. Unfortunately at this station the fall is not very great between the springs and the hatchery.

Mr. Nevin: In our hatchery between the spring pond and hatching house there is a distance of twenty-five feet, and the fry in the troughs do not do so well as in the main hatching building, or main pond, and that is on account of the excess of air.

Mr. Marsh: How does it get in?

Mr. Nevin: I don't know.

Mr. Marsh: Unless the air in the spring bubbles up from the bottom and presumably from quite a depth.

Mr. Nevin: There is probably nine feet of water in the pond.

Mr. Titcomb: Are there springs in the pond?

Mr. Nevin: Yes, sir.

Mr. Marsh: Is there bubbling of gas all the time?

Mr. Nevin: No.

Mr. Marsh: If that water could take up air only from the surface I do not see how it could get an excess. Is there any agitation in the water?

Mr. Nevin: No, none at all.

Q. Do the bubbles adhere loosely to the fish?

A. Yes.

Q. Can you see the bubbles in the water?

A. No, not loose in the water—I noticed them on the fish in the aquarium also.

Mr. Marsh: Those bubbles may not be due to excess—it may be an entirely different matter—I do not see how in this case there could be an excess of air.

Dr. Bean: I would like to ask whether a paper on this subject was not published in the Transactions, growing out of investigations on Long Island—a paper about two or three years ago, based on some observations at Cold Spring Harbor.

Mr. Marsh: In the fisheries transactions?

Dr. Bean: They are in the Fisheries Society's publication or in a Bulletin of the Fish Commission—I think I have seen a paper of that kind on the gas bubble disease.

Mr. Marsh: Yes, in the bulletin of the fish commission, and Prof. Gorman, the author of the article, is present tonight and perhaps may mention it. In that article he refers to the pop-eyed scup at Woods Hole, and there are specimens of them in the aquarium here now. As I said, that popeye I did not see here in the winter. The popeye that they have in the summer may be due to the same cause and may not—I do not know. Prof. Gorham's explanation was one of reduction of pressure, the scup having been taken from deep water and put in shallow aquaria. If there is a little gas in the tissue behind the eye it expands and pushes the eye out, the scup being particularly adapted to that occurrence.

Dr. Bean: I did not have that in mind, but it appears to me something was published a few years ago about a similar condition of trout on Long Island.

Mr. Marsh: I think in the report of the New York State Fish Commission for 1897 or 1898 there is a report by Prof. Calkins on an epidemic in trout on Long Island, but there was no gas concerned in it. It was due to a protozoan, Lymphosporidium, which killed the trout in great numbers.

Mr. Clark: Prof. Marsh has presented a very interesting paper; and to confirm what he states there in regard to the aera tion system, taking the air out of the water, I might state a little experience I had quite a few years ago, I think in 1875, 1876 or 1877, with some rainbow trout I was transferring from Northville to Geneva Lake for Mr. Fairbank, of Chicago, the lard man who died a short time ago.

He was spending quite a considerable amount of money in that lake, and Prof. Baird gave him some rainbow trout which were hatched at Northville, and I took them there myself. I had my fish rather thick in the can and was having a little trouble before I reached Chicago. However, I got them there without any great loss and immediately hurried my fish to the hydrant at the end of the Illinois Central depot, and paid a boy fifty cents to help me get fresh water to the trout, and I drew out one pail of water and put in a fresh pail, and before I got quarter around the fish were doing badly in the first can, and there were ten cans altogether. They were coming up and turning and making a great fuss. I kept giving them fresh water and my fish kept acting badly all the time. I knew there was something wrong, and I immediately commenced drawing the water off and stirring it and putting it back, and in less than an hour and a half I had my fish in good condition. I stopped using Lake Michigan water, and from that day to this I could not account for it; but Prof. Marsh has solved the problem. I knew there was too much air but I did not know why. Deaeration helped them, but I took the air out of the water instead of putting more air in.

Mr. Ravenel: Was this fresh water that you put in overcharged with air?

Mr. Clark: Oh, yes.

Mr. Ravenel: The mere pouring in of the water could not have been injurious?

Mr. Clark: No; because by the time I kept changing this water I had got pretty near all Lake Michigan water. You could see the air right in the water. Perhaps it is not so thoroughly charged with the air, but you could see the air in the water; but solved the problem to my satisfaction, and the explanation is that there was too much air in that water for those fish, and had I continued giving it to them I would have killed the fish. I could not understand the reason of the trouble at that time, only that we had too much of that kind of air, and now I see the problem that he brings up here is that you take the air out by deaeration, and I took the air out at that time by the stirring process.

Prof. F. P. Gorham: I am interested in the statement made by Mr. Marsh, because it is along the line upon which I worked some time ago. We must distinguish between two sorts of gas disease, the sort that Mr. Marsh describes, which undoubtedly is due to the superabundance of air in the water, and another gas disease which shows itself by the formation of gas bubbles in the tissues of the fish. These bubbles are behind the eyes, causing the "popeye," or under the epidermis of the fishes, causing the bubbles of gas which form on the fins. I think the second sort cannot be explained by the presence of too much air in the water. I do not see how you can get the air from the water, first into the blood and then out into the tissues of the fish to form the bubbles, without first killing the fish. The amount of air present in the blood vessels would soon kill the fish. A small bubble of air in the vessels will kill the animal almost immediately. The fishes which show the presence of "popeye" and large bubbles in the tissues, contain altogether too much air to have it produced in the blood vessels; it would have killed the fish at the very first. It seems to me that the explanation which I gave some five or six years ago accounted for the presence of the large amount of gas behind the eyes and in the tissues quite satisfactorily. The change in the pressure upon the gas in the air bladder of the fish, brought about by placing the fish in an aquarium allows the gas in the air bladder to expand, and it works itself out of the bladder through the tissues back of the eyes and into the fins. According to the species of fish in which it occurs it appears in various ways. To test this, a week or two ago I arranged an aquarium here in the hatchery, according to the plan advised by Mr. Marsh, allowing the water to pass through his deaeration apparatus before passing into the aquarium, and put in a considerable number of fish. In other aquaria I put control fish to notice the difference. I found that the external bubbles which Mr. Marsh describes and the bubbles of gas in the blood vessels, do not appear in the fish which are in the water subjected to this deaeration process, but I do find the "popeye" occurring. There is a fish in No. 1 aquarium over there now in which the bubbles of gas are forming behind the eye in just the way they do in the other aquaria, so that it seems to me we are dealing with two sorts of gas disease here, and we ought to distinguish between the two.

Mr. Nevin: Did you ever see air bubbles on the rainbow trout and see them floating on their backs?

Mr. Marsh: No. At the time I was at Erwin there were no fry with sacs, and whether such fry had these gas bubbles or not I don't know.

Mr. Lydell: I would like to ask Mr. Marsh if it is possible to take an air pump and pump too much air into water for fish?

Mr. Marsh: I think that is purely a question of how deep the water is. In an ordinary can I do not think you could get sufficient excess to harm the fish at all; but if you had a can eighteen feet deep or perhaps not quite so deep, and pumped a continuous stream of air to the bottom, I believe it would kill all the fish in the can after a while; the pressure of this high column of water drives the air into the water in excess. The water in the ordinary fish can seldom has an excess. I think there is a depth of only two or three feet and that would make an additional pressure of only a pound and a half about.

Mr. Titcomb: I can give a little experience about this superabundance of air in aquaria in connection with the ordinary ones used in drug store windows. I know of two instances where a beautiful lot of trout on exhibition in an aquarium about six feet long by about two or three feet wide in a drug store window, were all killed. The first lot of trout suddenly jumped out onto the floor as if at a signal. The aquarium was restocked and covered, and the second lot smothered in the aquarium; and you will find that in the ordinary city water supply, if you try to operate an aquarium, it is desirable to have a receptacle through which to pass the water in order to deaerate or regulate it, before it passes into the aquarium. If you pass it directly into the aquarium from the ordinary aqueduct supply, you will occasionally get this superabundance of air. It will come in big bubbles, and the fish will become uneasy immediately and dart about, getting out if they can. That was an experience I had a number of years ago.

Mr. Ravenel: I think that Mr. Marsh's paper is exceedingly interesting from the fact that I think he has explained the cause of our failure in Charleston, South Carolina, a year and a half ago. The Fish Commission used the same aquarium there that was used at Buffalo, except that the supply of salt water was drawn from a pond near by hand and pumped directly into the supply pipes just over the tanks. The suction pipe was a temporary affair and hastily put up under very adverse conditions, and although we did not notice any leaks, and we thought that every precaution had been taken to make the aquarium successful, several car loads of fish delivered in excellent condition died within from twenty-four to forty-eight hours. Later on we captured within a hundred yards of the aquarium, mullet squeatog and numbers of other fishes, and lost them almost as fast as we could put them into the aquarium. Mr. Marsh was sent down to investigate this matter, but before he arrived there the suction pipe had been changed from the pond and run to a distance of 500 feet to the end of the dock, so that when he got there the fish were not dying, and he had not seen the conditions that existed during the earlier part of the season. I discussed this matter with Mr. Marsh before his paper was read tonight, and I recollect very clearly that large numbers of the fish were covered with air bubbles, and after a while they began to swim zigzag around the aquarium, then they would turn around on their backs and swim on their backs for a while. Two carloads of these fish came from Tampa and one from along the Georgia coast. I am satisfied, bearing in mind the fact that the first suction pipe run was a temporary affair, that the water was supercharged with air, and I have no doubt at all but that the large death rate resulted therefrom. I must say, though, that I have also noticed the same thing at previous expositions on a very small scale. We have never lost such very large numbers of fish as we did in Charleston, and it is very hard for me to recollect whether the fish that we lost in Buffalo which were apparently affected in the same way, were fresh or salt water; but I am under the impression that they were fresh water fish supplied by the New York State Fish Commission. I think that this occurred when Mr. Marsh was there, as he spent quite a time in Buffalo studying the fungus question.

Mr. Marsh: I do not remember any bubbles at Buffalo.

Mr. Atkins: It seems to me that I have seen recently in some publication, some method described for determining accurately either the amount of air or the amount of oxygen in water, and I think it must have been some German publication. I have only an indistinct impression about it, and if such a thing can really be devised or has been devised, it might be very useful in avoiding such troubles.*

Mr. Marsh: Is this a practical method for any one to employ?

Mr. Atkins: That is my impression.

Mr. Marsh: If there is I would like very much to find it. A chemist takes the water in a flask and boils all the gas out collects and determines it as a gas.

The members can look at the fish now in the aquaria and take note of what a difference the difference in temperature apparently makes. You can keep the fish in aquaria to some extent as you have all seen. There are fishes there and they are not dying all the time, though I suppose they are dying to some extent. The water is now much warmer, perhaps forty degrees warmer, than when I was here first. Then it was at the freezing point and sometimes below, and it holds the maximum amount of air then. Now, with forty degrees increase in temperature the excess of air will be much less, and it lowers the death rate very markedly. In one tank of the mummichog minnow, there are a great many fish, and you will see them with little blisters all over their fins, but they do not die every day. They have been lying there since Tuesday when I first saw them.

*** Mr. Atkins later found the method referred to, described in the Allgemeine Fischerei-Zeitung, 1902, page 408.**

Now, in the winter, although the mummichog was the most hardy species we had in the aquaria, still they would die rapidly. Some lived two or three weeks, but all died, and some would die in a very few days—much more rapidly than they do now.

I might add to that about the popeye, that I think there is even another sort of popeye than the one mentioned by Prof. Gorham. I remember one case at the Manchester station where the lake trout had the eye almost out of the head, and you could puncture the globe of the eye and see the evolution of gas. I do not know that there is any excess of air there. If not that would remove any explanation from that direction. Now, the pressure explanation could hardly apply to them, because they have been at that station all their lives and have never been in deep water. I understand they were hatched there; that popeye is due very likely to bacterial infection, producing gas.

THE GOLDEN TROUT.

W. T. THOMPSON.

I wish to state right in the beginning that it is not my intention to present to the society a complete study of the golden trout, but rather a slight sketch of one of the least known but most beautiful of New England's fishes. I had almost said "New England's indigenous fishes," but on this point there is still a difference of opinion. Should we make bold to claim this distinction, such claim would be promptly challenged by a considerable body of ichthyologists, headed by Mr. Samuel Garman of the Museum of Comparative Zoology, who claim it to be a descendant of the German saibling, though they fail to enlighten us as to when, and how, it was transplanted into our waters. On the other hand, an equally distinguished body of scientists, including such eminent authorities as Drs. Jordan, Bean, and Quackenbos, while admitting its resemblance to the European form, claim that it is strictly of American origin, and not a naturalized production.

Its natural range is extremely limited. A few waters in Maine in addition to Danhole Pond and Sunapee Lake in New Hampshire, would comprise about all the waters where it has been found. It is probable that it is best known, however, as an inhabitant of Sunapee Lake. Rumors reach us occasionally that the Dominion waters contain examples of this rare trout, but up to the present time this claim has not been substantiated, the *so-called* golden trout, though somewhat similar in appearance and habit, proving to be the Canadian red trout.

Without some reference to the picturesque and beautiful description of their most ardent champion, Dr. Quackenbos, any paper on the golden trout would be as distinctly lacking in flavor as a Woods Hole meeting of this Society without a Rhode Island clam bake, or as that good old clam bake without the jovial and humorous president of the Wisconsin Fish Commission to voice our appreciation of the feast in his own characteristic manner.

But to return to my description: "Throughout the spring and summer the back is dark sea-green blending on the sides to a flashing silver, which in turn deepens below into a rich cream. But as the October pairing time approaches, the fish is metamorphosed into a creature of indescribable brilliancy. The nuptial coloration is gorgeous beyond example among our indigenous salmonidae, the deep purplish hue of the back and shoulders now seem to dissolve into a dreamy sheen of amethyst through which the inconspicuous pale lemon spots of midsummer flame out in points of lemon or vermillion fire, while below the lateral line, all is dazzling orange. The fins catch the hue of the adjacent parts and pectoral, ventral, anal and lower lobe of the cardal are ribboned with a broad white margin. Those who have seen the flashing hordes on the spawning beds, in all their glory of color and majesty of action, pronounce it a spectacle never to be forgotten."

Possibly a comparison with such a universally known fish as the brook trout will give many a clearer idea of its appearance. Head and mouth smaller, form more slender and tapering, back unmottled, in the adults, and spots without the blue aureola, tail more forked. The noticeably larger fins which lack the black stripe just inside the white border, are a delicate creamy yellow in color, though they appear a fleecy semi-transparent white edged with a clear shining ivory border. As they move quietly through the water with extended fins the general effect is airy and graceful in the extreme, reminding one of a beautiful yacht under full sail, and bearing the same relation, in appearance, to the ordinary trout as a cup defender does to a common cruiser.

There has been no systematic study made of the life history of this interesting variety. What little knowledge we have regarding it is not so much the result of direct investigation as a mere incident of the fish cultural work that has been carried on for some years past by the various commissions, the New Hampshire Commission being perhaps the pioneer in this direction, having operated at Sunapee Lake as far back as 1890. For much of my information along this line I am indebted to the courtesy of its preseident, Mr. Nathaniel Wentworth, who has had supervision of this special work for a number of years; also to his son, Mr. Edward Wentworth, who operated at Sunapee for the state for several years, and who has in connection with Mr. Dennis Winn carried on the field work with this variety for the past two seasons for Superintendent Hubbard of the United States Fish Commission.

Speaking briefly, and with special reference to the Sunapee fish: They inhabit the depths of the lake during the entire year, where they are out of sight and beyond the range of our observation, with two brief exceptions. These exceptional occasions are the result of food, and spawning instincts. In the spring they follow the spawning smelt into the shallow shore waters. They reappear again the last of October, on the reefs surrounding the lighthouse, where they deposit their own spawn, occupying only a week or ten days in so doing. During this period their color is most gorgeous, all below the lateral line being a flaming golden orange, fully warranting their popular name, "Golden Trout." This season of high color is almost as brief as the spawning period, the brilliant hues dissolving quickly into the usual silver coat. So changed is its appearance thereby that they were then called the "White Trout," and by many were formerly supposed to be an entirely different variety.

Probably no other trout has so short a spawning season. This fact renders the usual difficulties and uncertainties of netting fish in such exposed localities especially exasperating. A single storm at the critical period causing a great falling off in the egg harvest, and possibly even a complete failure of the season's work. The beds are made on the small stones, in comparatively shallow water, say under five feet. But little preliminary notice is given of their coming. No van-guard of stragglers heralds their approach. They appear in a body and begin the spawning operations at once. The height of the season extends from the second to the fifth day. The females vary greatly as to size. Ranging upwards from the six and eight-inch fish, with the bars still showing, and weighing only a few ounces, to the matured specimen of three and four pounds, their average being probably in the vicinity of one and one-half pounds. Fully eighty per cent are ripe when taken from the nets. The number of males on the beds is much greater, probably in the proportion of three to one. They are considerably larger in size, few immature specimens being seen.

The saibling is a sinewy and powerful fish, is a hard and persistent fighter, during the entire spawning operation, ceasing its struggles as the operator ceases, only to recommence with renewed vigor as he continues. Fortunately they have but little body slime; the scales are also moderately large, so that they are not so difficult to hold as they would otherwise be. There is a tendency to ovarian troubles, plugging, etc. Right in the midst of a free flow of eggs the vent may become as effectually plugged as though closed by a valve, though an abundant supply of eggs may still be plainly felt in the abdomen.

Prior to the present year there had usually been a difficulty in securing milt when actually needed to impregnate the eggs, though it flows freely while the males were being extricated from the nets. Heretofore the fish were placed in live boxes over night and spawned the next morning. The plan was varied the present season the spawning operations closing the night's work. The flow of milt was more abundant and of better quality, and as upwards of eighty per cent of the females were found to be ripe, there was an improvement both in quantity and quality of the eggs taken. This method has the additional advantage, that the spent fish are at once released without being unnecessarily injured by confinement in the live boxes.

Golden trout eggs do not stand transportation as well as those from the brook trout, either in the green or eyed stage. There is also greater loss amongst them during the various stages of incubation, whether as a result of imperfect impregnation, or arrested segmentation, I cannot say. The fry are somewhat longer and more slender than brook trout, and while the yoke sac is smaller, it is absorbed more slowly. I might also add that it is more completely absorbed before the fry can be induced to take food. In addition to the bars on the sides the shoulders and backs are irregularly covered with numerous black blotches of varying sizes and shapes.

The real difficulties in the way of propagation now appear. In fact, these difficulties are always appearing. Every fish culturist who has handled this variety has met with more or less failure, usually more. If there is a Mark Tapley among this membership I would suggest that this golden trout is the fish he is looking for. He can get all the honor and glory he wants.

Right now I want to emphasize three essential characteristic habits of the golden trout. At all stages of his existence he is a bottom feeder. He inhabits deep and cold waters. It is only by bearing these facts in mind that the fish culturist can hope to achieve any measure of success. I have always been an ardent advocate of feeding fry frequently and slowly, and only so much at a time as they would eat while in suspension, allowing none to fall to the bottom and foul the trough. We fed golden trout fry on that theory for two years and if one judged by their appearance, *theory* was the only thing we did feed them on. It was not a success. The first crop did not begin to thrive until almost one year old. The next lot was distributed as fry. We began feeding the past season's crop on theory again, and with the usual result. Then we discarded theory and used liver alone, with gratifying success. These fry are peculiar acting little fellows. Toward the latter stages of the absorption period they become congregated at the upper end, heads up stream, laying so close together as to hide the bottom of the trough, and as still as though glued to it. Day after day passes with scarcely a movement or change on their part, except that their slender form grows thinner and thinner. Frequent light feedings attract but little attention, the particles being carried rapidly over the compact fish mass by the current without inducing a rise. Seemingly they have neither desire for food, nor ambition to live. The body fades to a mere line. In the subdued light of the hatching trough they appear all heads and eyes, presenting a decidedly uncanny appearance, to say the least. I can assure you we didn't enjoy the sensation caused by the sight of those fish fading away day by day and week by week; but what could we do about it? All other fry took their food readily and easily when the proper time came. Others had found this same difficulty. It was very evident that the fault was with the fish. Dead fish tell no tales; that is, unless you have a bacteriologist in your commission.

But, as I remarked before, we dropped the theory, counted out a trough for rearing purposes and began feeding liver thickly at the head of the trough, allowing it to fall to the bottom. We soon found that before the time for the next feed they had picked up a considerable amount of this food. Continuing this practice we soon had the fish in a thriving condition, fully equal to our best brook trout fry, and realized that under proper conditions they were gross feeders and rapid growers.

When placed in the ponds they do not spread around as do most trout, but huddle in the dark corners darting erratically here and there whenever anyone approaches. It is necessary to wait until they become quiet and still in their usual location before throwing in the feed. Great care must be exercised in feeding only so much as they will pick up, as otherwise the pond would soon become foul. The fish now appear quite hardy, with no unusual tendency toward disease or fungus, but are very sensitive as to temperature. Our limited experience would indicate 55° as being the maximum to which they should be subjected, and a still lower one as being more desirable. If this condition can be met there need be no serious difficulty in rearing to the yearling stage, but beyond this the task becomes increasingly difficult. Few hatcheries have ponds of suitable size and depth, combined with proper temperature, to warrant any attempt to carry them to a greater age.

Before closing I wish to call attention to two peculiarities we have observed, first, our young fish have always been most active and healthy and have made the most rapid growth in the severe winter months, lessening in degree as spring approaches, when other salmonidae begin to thrive. This is probably due to the fact that the temperature and the subdued light of the short winter days most nearly approximate the conditions found at the depths they would ordinarily inhabit. The second is in connection with the marbling on the back. Our authorities all agree in telling us that this marbling is one of the marks by which it can be distinguished from the brook trout. Now it is one of the anomalous facts in connection with this fish that during a certain stage, intermediate, I may term it, this marbling is as plain as on the brook trout. During the second year, as the bars and blotches begin to fade, the marbling appears, apparently, as though it had been merely hidden from view by their more dense colors. Before attaining to full maturity these in turn fade from sight. The Canadian red trout is the only other fish, to my knowledge, that has this same peculiarity.

DISCUSSION OF MR. THOMPSON'S PAPER.

Near the beginning of his paper Mr. Thompson said: Since I have been aboard the Fish Hawk, I have had some conversation with Dr. Bean on the subject, he tells me that this variety was found here before there was any fish cultural work done in the United States. Such being the case, it is highly improbable that any specimens of the European saibling should have been received and successfully transplanted into American waters. This seems a very strong point in determining this question of origin.

Mr. Carter: I think Mr. Thompson spoke of the golden trout being found in the waters of New Hampshire and Maine only. They are also found in Northern Vermont; they are indigenous there and are found more abundantly in Little Averill pond than anywhere in the United States.

Mr. Thompson: I knew they were found there, but had the impression that they were transplanted.

Dr. Bean: This paper of Mr. Thompson's has interested me very greatly, and although its right to bear a distinct name has been challenged by Mr. Garman, what the author of this paper has written has given me a great deal of satisfaction, and I am also very glad to learn that the golden trout is native to other waters than those of Maine and New Hampshire—that is to be expected. Gentlemen, you know that the trout and salmon, numbering as they do about one hundred kinds of fish, as far as we know at present, are so little differentiated even today, that the experts differ in their notions as to what is a species and what is merely a local race. We know very little about the salmon, notwithstanding the investigations of the Fish Commissions of various countries. We know that they are widespread, that they are abundant in individuals, that they have curious life histories, varying with different climates, but as to the points in which they differ one from the other and may be recognized by the average man, there is no consensus of opinion. I doubt if there is a man today who can even tell whether the salmon originated in fresh water or in the sea. It is true that the Canadian Geological Survey found what appears to be a Pacific salmon in the clay shales of the Thompson river in British Columbia. I do not know whether this has been published or not, but it is a fact that a fossil nearly like the present well-known Pacific salmon, represented by a few individuals was taken in that river. Now, it may be that the fish originated in the fresh water, and if so the idiosyncrasies of its character will be better understood. We all know that of this type of saibling we have knowledge of at least half a dozen species beginning in the high north with the Floeberg char, then the Greenland char, extending to Labrador, and the red trout of Canada, the silver trout or golden trout or white trout of Maine, Vermont and New Hampshire, the blue-back of Maine, the Dolly Varden of the west, the white-spotted char of Kamchatka—those are all saiblings—and of course the well-known European saibling, over which a good deal of controversy has arisen, but which I believe has been taken with certainty in only one lake in the United States since its introduction, and that is Sterling Lake in New Jersey and New York; so that there is quite an array even of saibling that we know about. Now, if we could extend this inquiry to the fish that we do not know about, perhaps we would be as much surprised as the deep sea investigators of the United States Fish Commission are whenever they make a cruise. We have to deal only with what we know, and we know so little that I welcome this paper of Mr. Thompson as a distinct addition to our knowledge. We did not even know that this fish was marbled; we did know about the parr-marks, but the marbling is something new, and in that respect it brings it still closer to the brook trout. Of course the real distinction between brook trout, and the saibling, as you know, is an anatomical one, all the saiblings having a forked tail and all the brook trout having what is called a square tail; and the saiblings all have a little patch of teeth at the root of the tongue, which the brook trout, with some exceptions, lack. I am glad that this paper has been presented, and I know that it will be greatly valued by all who have heard it. (Applause).

Mr. Thompson: I would like to say that we have at the Nashua station some hybrids of the golden trout and the brook trout—the eggs of the golden trout being fertilized with the milt of the brook trout. These were eggs taken at the latter end of the season, we had no suitable milter amongst the golden trout, so used milt of the brook trout. These fish are now upwards of a year old and show to a certain extent the characteristics of both parents. They have to a lesser degree than the brook trout the black line inside of the white margin on the fins. As to the marbling, of course we cannot tell whether that will disappear or not, but it is very plain now. They are not quite so slender as the saiblings but are more slender than the brook trout, and are very uniform in appearance—almost as uniform as any of the species. There is not a very great difference as to size—not more so than would be found amongst any fish of the same age. They do not feed in quite as great a depth of water as the golden trout, and yet lower than the brook trout. Our golden trout in the ponds, as I stated in my paper, huddle in some dark corner. The ponds we have kept them in have plank bottom, covered with sand, and they swim so low that in a very few days the movement of the fins brushes that sand all away, leaving the bare surface of the boards exposed. While our hybrids swim in much the same manner, they do not work the sand off so quickly, they have partaken almost equally of the characteristics of each of the parents, and show very decided resemblance to each of them, being half way between the two varieties, and I think it would perhaps be interesting for some of our scientists, if they would examine them more critically than we fish culturists can.

Mr. Nevin: What is the fact as to the shedding of teeth during the spawning season?

Dr. Bean: I heard it reported frequently, but I have never made the observation myself. Of course the shedding of teeth during the breeding season is not at all uncommon. Many fishes do that.

Mr. Nevin: They do not do it during the breeding season.

Dr. Bean: The pike-like fishes and salmon are not very far apart in a good many respects, and I should expect to find that the pike and muscalonge, which belong to the same family, would show much the same habit as some of the salmon—that appears to be related to the spawning time.

Mr. Waterhouse: Can that hybrid trout breed?

Dr. Bean: Oh, yes, it is quite fertile, and so is the cross between the brook and the lake trout, but they are so closely related generically that there is no reason why they should not be.

Mr. Nevin: We have had quite a number in our pond, and they never bred.

Dr. Bean: Pennsylvania has bred many of them and got eggs from them.

Mr. Thompson: Some of the European culturists advertise hybrids 7-8—that would indicate two crossings with the hybrid.

Dr. Bean: I believe the rule so far as known is this, where a small-scaled fish of the salmon family is crossed with a large-scaled fish, the cross is never fertile, but if a large-scaled fish is interbred with a large-scaled and a small-scaled with a small-scaled fish, within the limits of the genus, the cross is always fertile.

Mr. Nevin: There is no cross between the brown trout and the brook trout?

Dr. Bean: No, because the brook trout is small-scaled. The scales are so small that many people think they have no scales, and the brown trout is a large-scaled fish.

Mr. Waterhouse: Is that a matter of theory or settled by experiment?

Dr. Bean: Settled by experiment.

SOME NOTES ON FISH FOOD IN THE LAKES OF THE SIERRAS.

BY H. B. WARD.

During the month of June of this year I had the privilege of spending some time at Glen Alpine Springs, California, which is located in the Sierras, close to a series of lakes of considerable altitude. A cursory biological examination of these lakes disclosed biological conditions which may be of considerable interest to members of this Society. What may have been the early condition of the lakes, I do not know, but from the precipitous character of outlets and the long stretches intervening between them and other waters, together with the limited amount of outflow, it seems impossible for fish to gain a footing. From time to time, however, within recent years, plants of trout have been made in these lakes with varying degrees of success. There are consequently two questions which will come at once to the minds of all members of the Society; first, what is the source and character of the food on which these forms have subsisted? Second, how far have they adapted themselves to their environment in the process of becoming a permanent part of it? Although the study could not be extensive in the time at my disposal, even a brief survey disclosed some features of considerable interest, which I desire to present in tentative form at this time.

A few words regarding the lakes themselves may not be out of place. They are all located near the southeast corner of Lake Tahoe, and empty their waters ultimately into that lake, through the medium of a smaller body known as Fallen Leaf Lake; the latter is located directly south of the main lake, and separated from it only by a low alluvial plain not quite two miles in width, so that one may regard this smaller lake as but a branch of the larger one. Following the inlet of Fallen Leaf Lake, upward and away from this body of water, the valley ascends very rapidly and the channel of the brook is little more than a succession of rapids and falls, in some cases of considerable height. The amount of water in it during the early part of the year, while the snows of the higher regions are melting, is considerable, but is said to dwindle markedly later in the summer. In the course of this brook and its branches are located the half dozen smaller lakes which were the particular objects of this study. They are known locally as Grass Lake, Lily Lake, Suzy Lake, Heather Lake, Half Moon Lake, Gilmore Lake, and their similarity is rather striking. In size, from a quarter to a half mile in length, they are for the most part deep pockets with little or no shore area and vegetation, and with the major portion of the margin and bottom of rock formation. In altitude they vary from 6,300 feet to about 8,000 feet. At the time of the visit the lower lakes were entirely free from ice and snow, and the water had risen at the most favorable points to a temperature of sixty to seventy degrees, although this obtained only over limited areas of surface water. At the same time the upper lakes were still ice-bound in part and fed exclusively by mountain snow banks, so that the temperature of the water was everyhere low.

I made a series of collections, both from the shore and deep water in these lakes, and the result of the same is shown in the table at the close of the paper. It was indeed remarkable that the lakes contained so little in the form of microscopic life. Neither plant nor animal forms seemed to be present in considerable numbers or in any variety. A few of a single species of entomostracan was all that any lake contributed from this group, while in some not a single member of it was captured. Apparently, then, at this season the microscopic crustacea can afford little or nothing in the way of food supply for the lakes. In shallower pools adjacent and sometimes connected with the larger lakes I found numbers of these forms; but still more numerous and striking was the development of insect larvae. These collections are also noted in the table. The trout which were caught in the different lakes varied greatly in robustness. From certain lakes they came plump and well fed; from others, however, the fishermen reported that they were "all head," having had a hard time during the winter, and being thin and poorly nourished at present, a fact which stands in interesting connection with the absence of the plankton organisms from these lakes.

One other interesting fact deserves mention in this connection. I was privileged to examine the stomach contents of a duck which had been collected from one of these lakes for the United States National Museum, and noted here also the absolute want of those small crustacea which elsewhere form so large a part of the food of these aquatic birds. Practically the entire mass of stomach contents was composed of mature insects with a few larvae, and this agreed fully with the observations regarding the food of trout. The insects had apparently pushed into these regions from lower altitudes at a date in advance of the development of the local fauna. They were present in the region in considerable numbers, the trout were taking the fly eagerly and were voracious after grubs and larvae. It is a fair question, then, whether under such circumstances the problem of support for the trout is not simply an entomological one. Of course, one must recognize clearly the insufficiency of such brief and scanty observations, but the universal testimony of the series of collections cannot help being suggestive.

Regarding the question of the adaptation of the animals to their environment, I have only one observation to record. At Gilmore Lake, for instance, the various sources of inflow are so scanty in volume, and so precipitous that even at this season of maximum intensity, they could not, without considerable local interference, be made available as spawning grounds for the fish. The latter must consequently spawn in the main lake, if at all. The same can be said of some, though not all of the other lakes. It is the firm belief of those residents best qualified to testify that the fish have established themselves, and it would certainly be most important to determine precisely in what way this has been done. In fact the biological problems suggested are of the greatest economic importance and scientific interest, and afford some probability of their solution in the sharply limited territory which is concerned as well as the virgin character of the water previous to the introduction of the fish. A more careful and extended study of the region would furnish data of value for practical fish culture, and of scientific interest as well.

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O'Hage, Dr. Justus, St. Paul, Minn.
O'Malley, Henry, Baker, Washington.
Orr, W. J., Bay Port, Mich.
Osborn, William, Duluth, Minn.

Page, P. W., West Summit, N. J.
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Perdum, James K. P., Woods Hole, Mass.
Pike, Robert G., Middletown, Conn.
Plumb, Charles, Mill Creek, Mich.
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Powers, John W., Big Rapids, Mich.
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Wilson, S. H., Cleveland, O.
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Zalsman, Philip G., Paris, Mich.
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Lake St. Clair Shooting and Fishing Club, Detroit, Mich.
New York Association for the Protection of Fish and Game, New York City.
Peck, Hon. Geo. W., Milwaukee, Wis.
South Side Sportsmen's Club, Oakdale, L. I., N. Y.
Sweeny, Dr. R. O., Lester Park, Duluth, Minn.
The President of the United States.
The Governors of the Several States.
Woodmont Rod and Gun Club, Washington, D. C.
Cortelyou, Hon. Geo. B., Washington, D. C.

CORRESPONDING.

Apostolides, Prof. Nicoly Chr., Athens, Greece.
Armistead, J. J., Dumfries, Scotland.
Birbeck, Edward, Esq., M. P., London, England.
Brady, Thos. F., Esq., Inspector of Fisheries, Dublin Castle, Dublin, Ireland.
Calderwood, W. L., Esq., Inspector of Salmon Fisheries, Edinburgh, Scotland.
Feddersen, Arthur, Copenhagen, Denmark.
Feilding, J. B., Upper Downing, Holywell, North Wales.
Giglioli, Prof. Enrico H., Florence Italy.

Ito, K., Member of Fisheries Department of Hokkaido and President of the Fisheries Society of Northern Japan, Sapporo, Japan.

Jaffe, S., Osnabruck, Germany.

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

Landmark, A., Inspector of Norwegian Fresh Water Fisheries, Bergen, Norway.

Lundberg, Dr. Rudolph, Inspector of Fisheries, Stockholm, Sweden.

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

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

Olsen, O. T., Grimsby, England.

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

Smitt, Prof. F. A., Stockholm, Sweden.

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

Trybom, Dr. Filip, Stockholm, Sweden.

RECAPITULATION.

Active	386
Honorary	55
Corresponding	20
Total membership	461

CONSTITUTION

(As amended to date).

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relting to the fisheries; the uniting and encouraging of all 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 one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar 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.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

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 office until a year after the expiration of their term; a Corresponding

Secretary, a Recording Secretary, a Treasurer and an 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.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Standing Committees.
5. Committees appointed by the President.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
6. Reading of papers and discussions of same.
    (Note—a. In the reading of papers preference shall be given to members present.
    b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society).
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

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 said meeting.