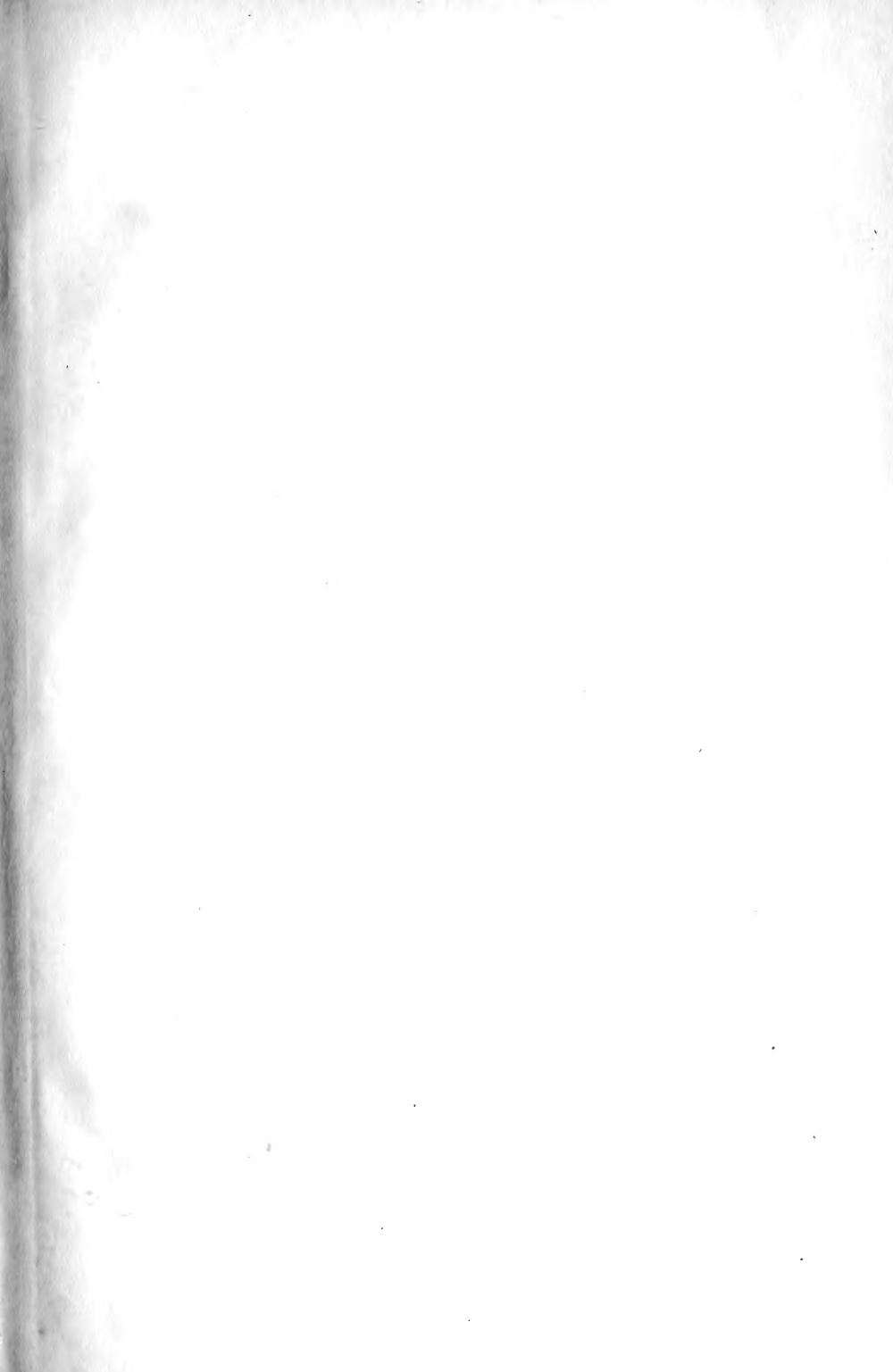


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TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-second Annual Meeting

JULY 21, 22 AND 23, 1903,

At Woods Hole, Mass.

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THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
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1903-05

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.



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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.

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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 Waterest 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.
Litchford, 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 earli-

est 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 ar-

range for the order of reading, so that it can be announced 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
	<u>\$347.99</u>
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. E. 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, Bullochvine, 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 Wasaington 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. Titecomb: 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. Titecomb: 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. Titecomb: 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 commit-

tee, 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 invita-

tion 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 heaven 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 num-

ber 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 peo-

ple 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 following 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 ap-

plause) 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 de-

tained 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 American 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 ordinary ship stuff from the mills, boiled stiff and dough rolled out in sheets, and then cut up into little squares, 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 successful 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 fel-

low, 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 with-

out 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 ear 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 assim-

lated, 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. Titecomb: 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 entomostraca, 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, con-

sisted 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. Lugin'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 Lugin, 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 pro-

cure 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 thrived 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 $\frac{1}{2}$ to 1 meter long, $\frac{1}{4}$ to $\frac{1}{2}$ meter wide and $\frac{1}{4}$ to $\frac{1}{2}$ 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 acci-

dent 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, "Dertien," 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 caught in Rivers, in Lobster time at the Rockies, in Maerill 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 Beeffe. 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 mul-

titudes 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^o. 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 pson, 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 forfeet for every hundred of such fish so imployed for manuring of ground twenty shillings & so pportionably for a lesser or greater number; pvided, 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 "Kennonog," another generic term. "Hence we think, "Suckieag," 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" (Hoon, 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 "twalfit" 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 forfeet 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 Piscataqua; 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 spe-

cies 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 in-

teresting. 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 or 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 scarr'd 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 every effort 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.

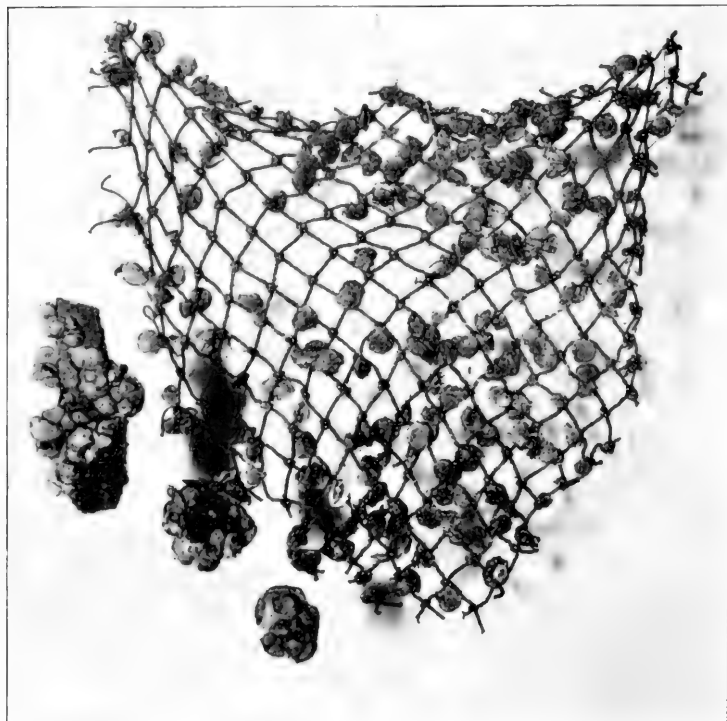
Both boxes are marked for "exhibition" and should be taken care of promptly on their arrival. We have packed them in moss as you suggested, but the journey is a long one and the specimens should not be allowed to remain in boxes till the exhibition opens up some ten or twelve days hence. The flat box 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 Adirondaek 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 unfortunately 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 wherever 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 190°. 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 crappie, 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, crappie, 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. Titecomb: 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.

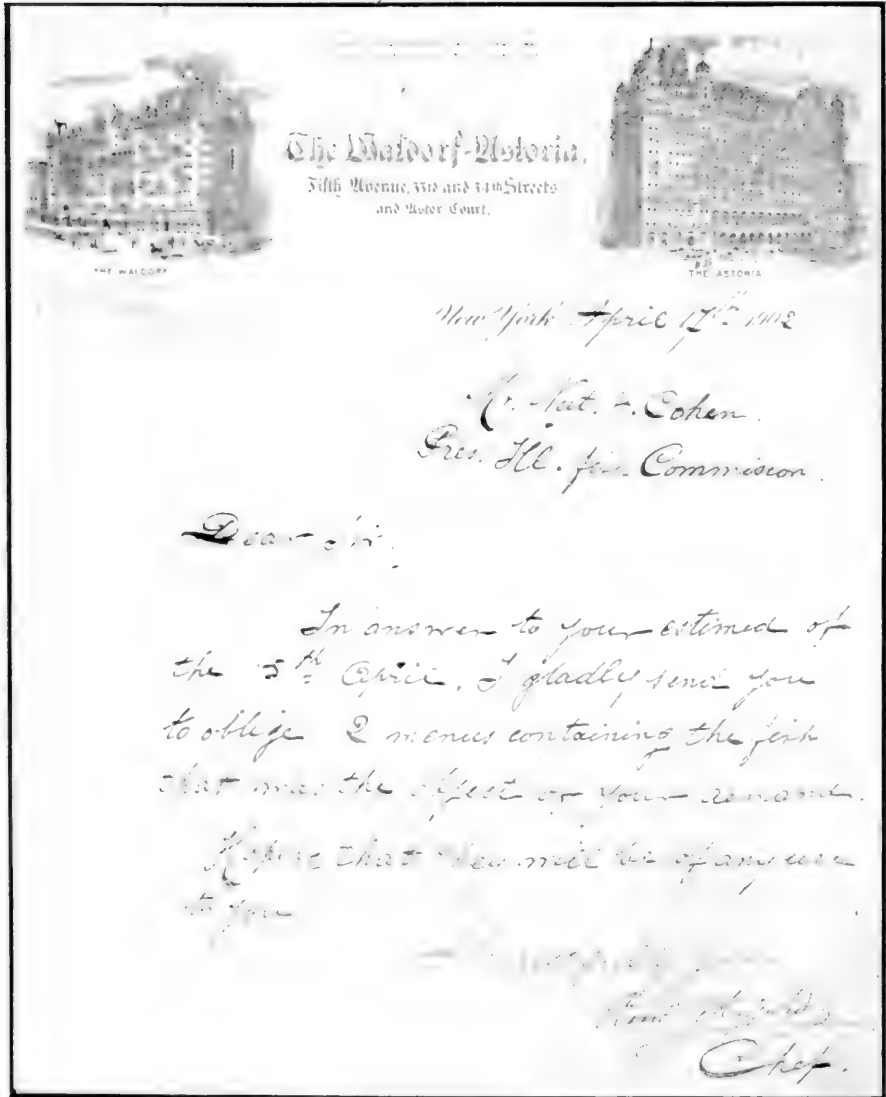
Dr. Henshall: The Jack salmon or wall-eyed pike is native to the upper Ohio and requires rather deep water, but the ponds

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.



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	Bigluga Caviare 1 50	Spiced Cantaloupe 30	Sardines 35	Stuffed Olives 30	30
Lyon Sausage 50	Celery 50 30	Pickled Beets 30	Thon Mariné 40	Anchovy Salad 50	
Ripe California Olives 25	Pearl Onions 25	Spring Onions 25	Pin-Money Pickles 20		
Cream Parmentier 50 30				Sagou 35 20	
Potete 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	
Stratford Gombou 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 30		
English Sole 1 00			Brook Trout 1 00		
X Carp, Rhine Wine sauce 65 40	Smelts, Melba 75 40	Kingfish, Bonne-femme 85 60			
Bluefish, Italian sauce 70 40		Baked Halibut with cream 70			
Fresh Mackerel, Maître d'Hôtel 65	Weakfish sauté with butter 65 40				
Eggs Monseigneur 50					
Broiled Mushrooms 1 00			Terrapin 3 00		
Lamb Chops, Fremouse 70 40			Fried Calf's Brains, Tomato sauce 65 40		
Ham with spinach 65 40			Aliguettes 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 30	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	Cépes 60			
COLD					
Game Pie 1 00 60	Brook Trout in jelly 1 00	Chaudroid 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 80			
Crab, Ravigotte 50	Hain 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 35	
Cream Gervais 25	Roquefort 30 20	Philadelphia Cream 25 15	Port Salut 30 20	American 20 15	
English Dairy 40 15	Camembert 30 20				
Cheddar 80 20	Stilton 40 25	Canadian 25	Pont l'Evêque 30 20		
Strawberries 50 30	King Tangerines 25		Oranges 25 15		
Bananas 20	Apples 35	Malaga Grapes 50 30	Pears 60 35	Grapefruit 50 30	
Cassava Pudding 40 25	Kummel Omelette Souffée 50			Peach Pie 20	
Lemon Custard Pie 20				Chocolate Baba 30	
Assorted Eclairs 25	Savarin 35	Baba 35	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				
Food Coffee 30	After Dinner Coffee Cup 15	Café Parfait 25	Butter Milk 10		
Small Portions are served in Café and to one Person only.					
IOHANNIS-LITHIA 40 20					

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 occa-

sional 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 first 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 myrriophyllum, 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).

Mr. 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 cruppy 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 some 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 with 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 prop-

osition, 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. Titecomb: 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. Titecomb of course, is something which would afford some distinct advantages, and we shall take it up.

Mr. Titecomb: 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 pro-

duced. 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 ob-

served 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-in-Bay, 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 sev-

eral 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 think 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 continued to do until the newly hatched fry were completely covered. Then he immedi-

ately 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.

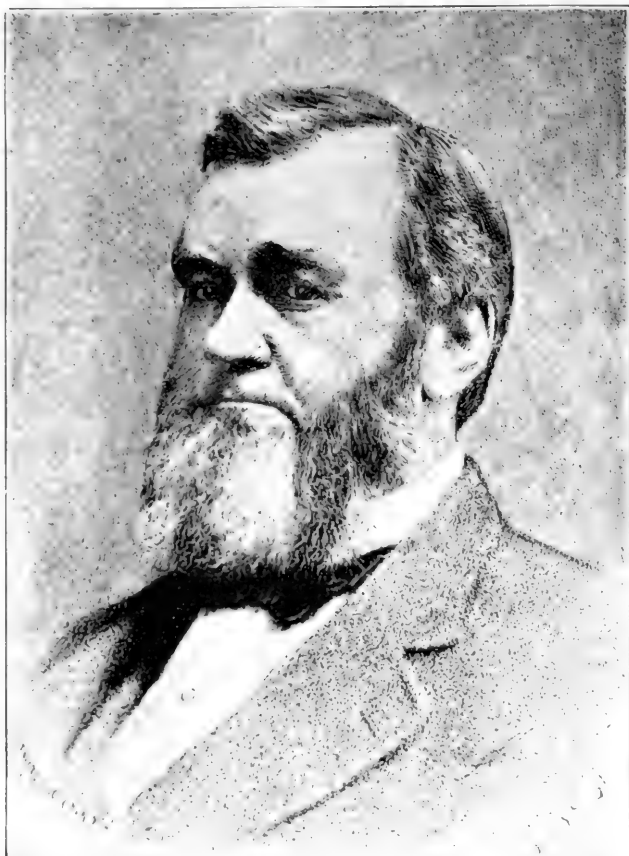
The meeting was called to order by the President, who spoke as follows:

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,



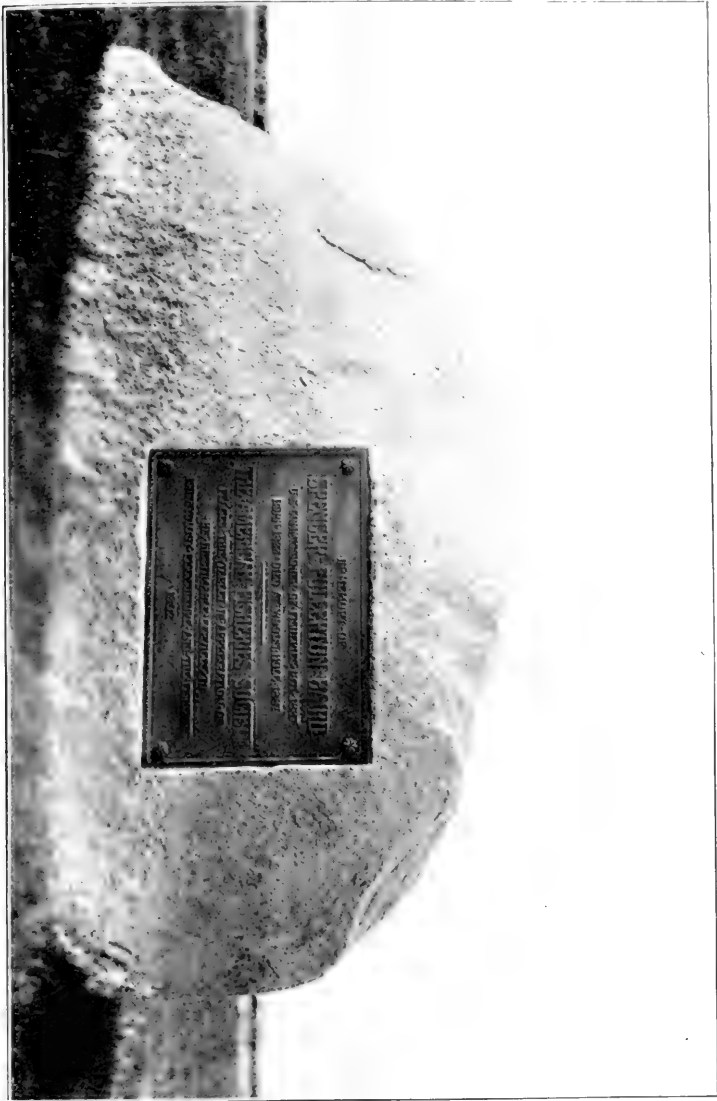
SPENCER FULLERTON BAIRD.

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. 1932."

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 Nonnasset, 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 Physi-

cians 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 freshmen 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 1849. The early correspondence with such men as George N. Lawrence in 1841; with Cassin and John G. Morris in 1843, and with Brewer, and Halderman 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 enthusiastic work in organization of the extensive govern-

ment 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 eulogiums 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 in 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 Yezo, 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 Exhibition 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 unflinching 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 disinterestedness 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 in-

exhaustible 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 multi-

plied 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 which¹ 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. Titecomb: 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. Titecomb: 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, "pop-eye" 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 pop-eye. 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 pop-eye of the scup and other summer species is not necessarily included here. There is undoubtedly more than one kind of pop-eye.

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. Titecomb: 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 popeyed 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 aeration 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 403.

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 caudal 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 president, 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 milt 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 everywhere 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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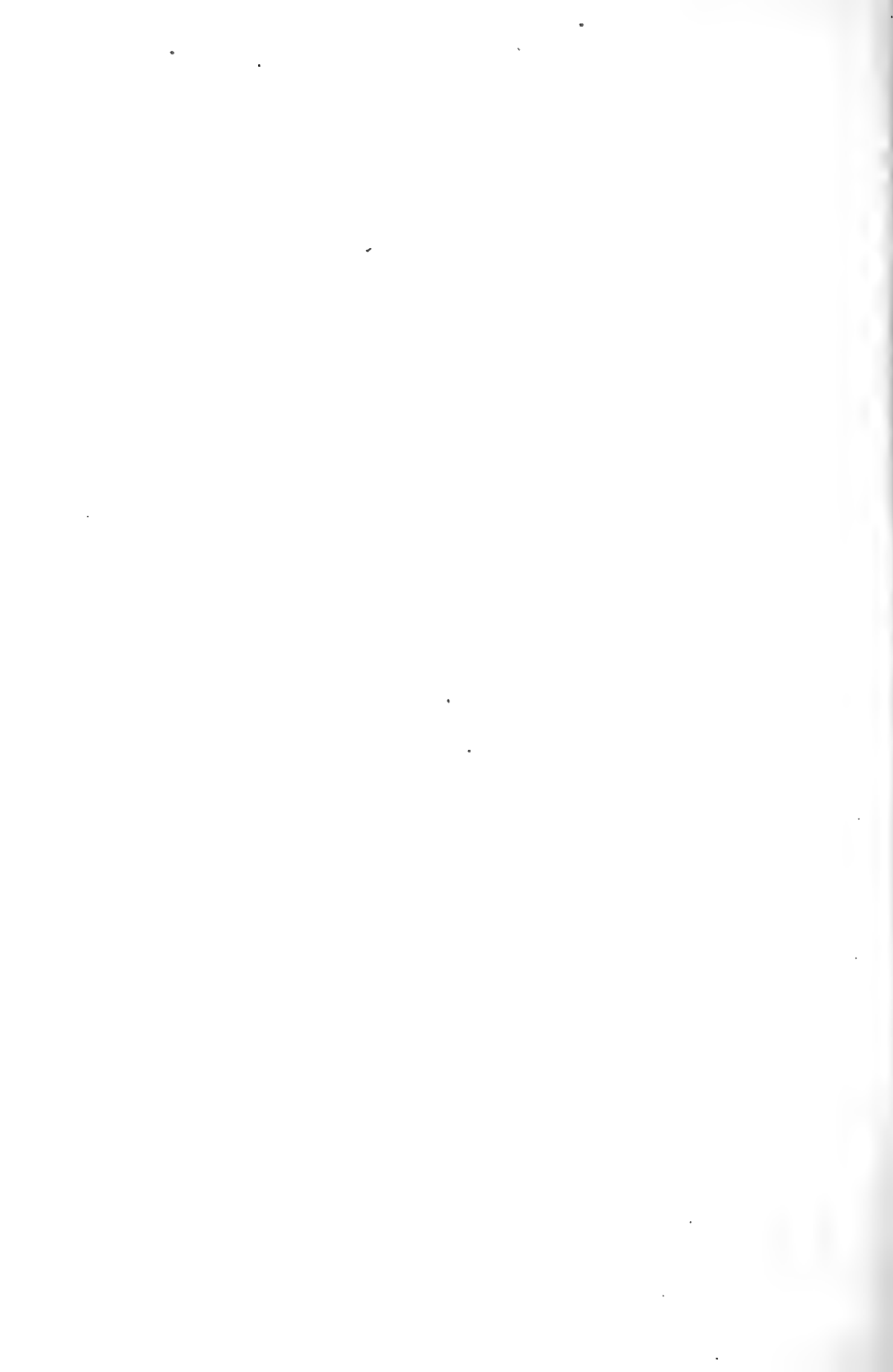
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- Trybom, Dr. Filip, Stockholm, Sweden.

RECAPITULATION.

Active	386
Honorary	55
Corresponding	20
	<hr/>
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 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.



1

TRANSACTIONS

OF THE

AMERICAN
FISHERIES SOCIETY

AT ITS

Thirty-third Annual Meeting

JULY 26, 27 AND 28, 1904.

At Atlantic City, N. J.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1904.

Officers for 1904-1905.

<i>President</i>	HENRY T. ROOT, Providence, R. I.
<i>Vice-President</i>	C. D. JOSLIN, Detroit, Mich.
<i>Recording Secretary</i>	GEORGE F. PEABODY, Appleton, Wis.
<i>Corresponding Secretary</i> ,	CHARLES G. ATKINS, East Orland, Me.
<i>Treasurer</i>	C. W. WILLARD, Westerly, R. I.

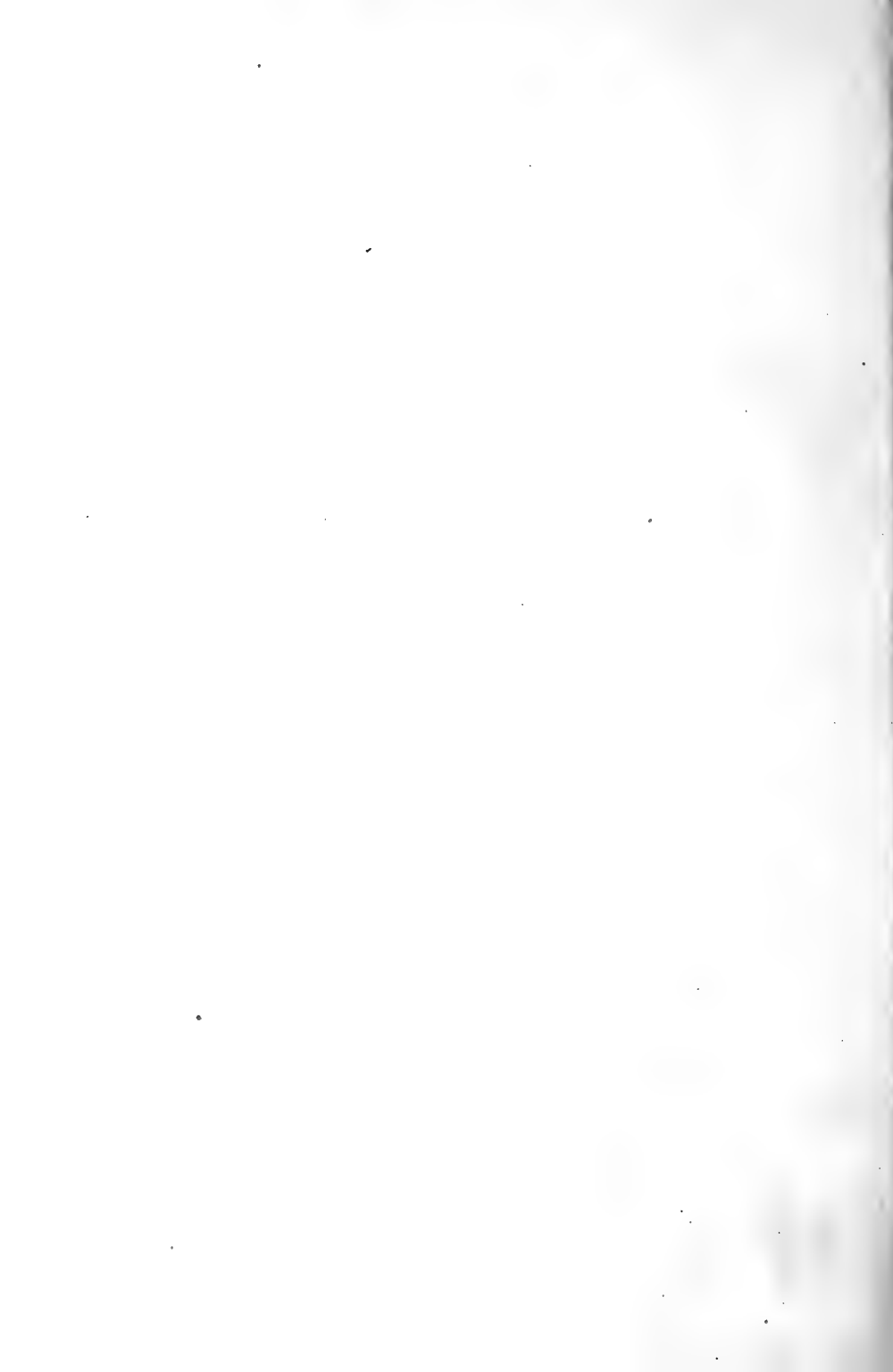


EXECUTIVE COMMITTEE.

WILLIAM E. MEEHAN, <i>Chairman</i> ,	Harrisburg, Pa.
HUGH M. SMITH,	Washington, D. C.
JOHN D. WHISH,	Albany, N. Y.
E. H. GEER,	Hadlyme, Conn.
JAMES A. HENSHALL,	Bozeman, Mont.
G. H. LAMBSON,	Baird, Cal.
J. J. STRANAHAN,	Bullochville, Ga.

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PART I.

BUSINESS SESSIONS.



Transactions of the American Fisheries Society.

Tuesday, July 26, 1904.

Convention called to order at 12 m. by the President, Mr. Frank N. Clark, of Northville, Michigan, at Young's Hotel, Atlantic City, New Jersey, whereupon the following proceedings were had:

PRESIDENT:—Gentlemen of the American Fisheries Society, you will please come to order.

Our committee last year added another article to our constitution, on order of business, and therefore we will proceed somewhat differently from what we have previously, following this order, and the first thing to be taken up is roll call.

Secretary:—As there are over 350 members of the Society, I suggest that a register of attendance be made.

President:—That is a good suggestion, and will be adopted.

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

Atkins, Charles G., *East Orland, Me.*

Baldwin, O. N., *U. S. Bureau of Fisheries, San Marcos, Tex.*

Bean, Tarleton H., *World's Fair, St. Louis, Mo.*

Boardman, W. H., *Central Falls, R. I.*

Booth, DeWitt C., *Spearfish, S. D.*

Bower, Seymour, *Detroit, Mich.*

Bower, Ward T., *Baird, Cal.*

Bowers, George M., *U. S. Commissioner of Fisheries, Washington, D. C.*

Brown, George H., *U. S. Bureau of Fisheries, Washington, D. C.*

- Buller, A. G., *Erie, Pa.*
 Buller, H. M., *Bellefonte, Pa.*
 Buller, N. R., *Pleasant Mount, Pa.*
 Buller, William, *Corry, Pa.*

 Capehart, W. R., *Avoca, N. C.*
 Carter, E. N., *U. S. Bureau of Fisheries, St. Johnsbury, Vt.*
 Clark, Frank N., *Northville, Mich.*
 Cobb, Eben W., *St. Johnsbury, Vt.*

 Dean, H. D., *U. S. Bureau of Fisheries, Neosho, Mo.*
 Dennis, Oregon Milton, *Baltimore, Md.*
 Dinsmore, A. H., *East Orland, Me.*
 Douredoure, Bernard L., *Philadelphia, Pa.*
 Downing, S. W., *Put-in-Bay, O.*

 Ellis, J. Frank, *U. S. Bureau of Fisheries, Washington, D. C.*
 Evans, Barton D., *Harrisburg, Pa.*

 Finch, George C., *Thompsonville, Conn.*
 Fisher, John F., *Chapinville, Vt.*

 Geer, E. Hart, *Hadlyme, Conn.*
 Green, C. K., *Washington, D. C.*

 Hagert, Edwin, *32 N. Sixth St., Philadelphia, Pa.*
 Hamburger, J., *Erie, Pa.*
 Henshall, James A., *Bozeman, Mont.*
 Hubbard, Waldo, F., *Nashua, N. H.*

 Jennings, G. E., *Fishing Gazette, 203 Broadway, New York City.*
 Johnson, F. W., *Boston, Mass.*
 Johnson, Alexander, *Erwin, Tenn.*
 Joslin, C. D., *Detroit, Mich.*

 Lambson, G. H., *U. S. Bureau of Fisheries, Baird, Cal.*
 Lane, George F., *Silver Lake, Mass.*
 Leary, J. L., *U. S. Bureau of Fisheries, San Marcos, Tex.*
 Locke, E. F., *Woods Hole, Mass.*
 Lydell, Dwight, *Mill Creek, Mich.*

 Mathewson, George F., *Enfield, Conn.*

Meehan, W. E., *Commissioner of Fisheries of Pennsylvania, Harrisburg, Pa.*

Miller, Charles L., *Altoona, Pa.*

Milligan, J. D., *U. S. S. Fish Hawk, care of Fish Commission, Washington, D. C.*

Morton, William P., *Providence, R. I.*

Noris, J. Olney, *President State Game and Fish Protective Assn., 317 N. Charles Street, Baltimore, Md.*

O'Malley, Henry, *U. S. Bureau of Fisheries, Baker, Wash.*

Palmer, T. S., *Washington, D. C.*

Peabody, George F., *Appleton, Wis.*

Race, E. E., *Green Lake, Me.*

Roberts, A. D., *Woonsocket, R. I.*

Robinson, Robert K., *White Sulphur Springs, W. Va.*

Root, Henry H., *Providence, R. I.*

Seagle, George A., *Wytheville, Va.*

Slade, George P., *309 Broadway, New York City.*

Smith, H. M., *U. S. Bureau of Fisheries, Washington, D. C.*

Stone, Livingston, *Cape Vincent, N. Y.*

Stranahan, J. J., *Bullochville, Ga.*

Titcomb, J. W., *U. S. Bureau of Fisheries, Washington, D.C.*

Townsend, Charles H., *New York City.*

Wallich, Claudius, *U. S. Bureau of Fisheries, Oregon City, Oregon.*

Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*

Whitaker, A. R., *Youngsville, Pa.*

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

Wires, S. P., *Duluth, Minn.*

Wood, Frank, *Edenton, N. C.*

Worth, S. G., *Edenton, N. C.*

Dr. Smith: I have an axe to grind! I have not heard that the society has offered any premium for the member who brings in the largest number of new members, but if that is the case I should like my claims to be considered. For a couple of weeks

I have been interviewing some of my friends in Washington, and I have what I think is a respectable list of new members to propose.

Dr. Gill, I believe, was one of the founders of the society, and is very glad to return to our membership. He told me that he had dropped out because the dues were so small that he could not remember to pay them. (Laughter.)

In regard to Dr. Palmer, he is in charge of the important work in game protection now being carried on under the department of agriculture.

Mr. Chester K. Green is a son of his father. (Applause.)

Mr. Meeham: I have not as large a list as Dr. Smith has. I have a list here that I would like to submit, of applicants for membership. I have sent the names to the secretary, and trust that they will be acted upon favorably.

President: It is very interesting indeed to have these long lists, including many noted men in connection with the fishery interests, and if there are any more we will be glad to receive them at the present time.

Mr. Robinson: I have a list of names of persons who desire to become members of the society, and I will file it.

Secretary: The secretary has received through the mail a number of applications for membership during the last year and they are subject to election with these other names by the society. I beg to say as secretary that the work of Dr. Smith is most encouraging to the society, and I believe many of the members of the society could bring in like reports if they would interest themselves sufficiently to present the usefulness of the society to their friends and those who ought to belong to it, and as secretary I would ask that every member present would, during the coming year, make every effort to interest every one who ought to be interested in this society; and any literature that they may want to help the matter along I shall be pleased to send them.

President: The next order of business is reports of officers, and first the annual address of the president. (Applause.)

One year ago you chose to elect me as your presiding officer, an honor I assure you that I have greatly appreciated.

The assembling of a representative body of men in any capacity is considered highly proper and generally of much good. But the gathering of representatives from various parts of this our country to devise means whereby the whole world, perhaps, may be benefitted, is an object well worthy of our greatest and best thinkers. Therefore, I extend my congratulations and wish you well in whatever may be done at this the 33d meeting of the American Fisheries Society, and trust your sojourn here may be both profitable and pleasant. The surroundings are, to say the least, pleasant and agreeable to our comfort.

To our energetic secretary we are very much indebted, and I wish especially to congratulate him on the very valuable report issued at his hands.

There is still room for congratulations in our increased membership from 169 in 1898 to 386 in 1903. There should however, be some action taken towards a still greater increase which would accure to our own good as well as those outside the fold.

Our meeting at Woods Hole was one of the best ever held but can we not make this still better? The past year has been one of trying times for many of those engaged in practical fish culture, but the tide has been stemmed and a brighter outlook is just ahead.

Since we last met as a society the grim reaper has invaded our ranks. While returning from our last meeting Gen. E. E. Bryant was stricken down. Gen. Bryant, as is well known, was a great inspiration to our meetings and to the individual members of our society as they came in contact with him. A full report of his life and its connection with the fishery interests of the United States will be given by our recording secretary, Mr. Peabody.

Fish culture, so far as it relates to living swimming organisms, is no longer in its infancy in the United States and Canadian provinces. When we are producing upwards of two billion annually it must be conceded that our factories are running normally at least, not to say the output cannot be increased with additional capital.

We still have some hard problems to solve. One especially

which your chairman thinks should receive more attention by both state and national authorities; that of food for these two billion of living, swimming, helpless fry. More attention should also be given to controlling the refuse matter that is polluting the waters and destroying not alone the fry but the feeding and spawning grounds of both fry and adults.

It will be remembered by the members present at our last meeting that the time and place for this annual meeting was left to a committee composed of the president, vice-president and secretary. This committee met in Chicago on January 15th and after carefully considering the numerous invitations Atlantic City was unanimously selected and you are now assembled at the 33d annual meeting of the society, and your chairman trusts we will have a very successful meeting both in a business and social way.

Again I wish to express my appreciation of the very distinguished honor you conferred on me one year ago by electing me president of your society.

That we may not be longer detained, as our programme for the three days is full to overflowing with interesting and instructive papers and discussions, and that we may give them our best attention and endeavors, your chairman will ask, what is the pleasure of the meeting?

We will now listen to the report of the secretary.

Secretary: If there are any of you who have not already received the report of the secretary in printed form, I should be pleased to deliver it to you. The printed volume of transactions constitutes the report of the secretary. I might add however, that the duties of the secretary have been very much lightened by the helpful work of the committees and all members who have had opportunity to lend their aid. The president and treasurer have come in closest contact with the secretary and have in every instance been helpful and done all that they could to lighten the burdens of the secretary.

(Report of secretary adopted.)

Report of treasurer and reports of standing committees passed for the present.

President: The next matter in the order of business is the appointment of committees by the president, and I would say that there are three standing committees to be appointed: one is the committee of five on nomination of officers for the ensuing year; another committee to be appointed is a committee of three on time and place of meeting. In order that these committees may be able to get to work immediately they will be appointed now. Heretofore a motion was necessary to appoint these committees, but now our constitution provides for it. I have tried to distribute the membership of the committees fairly as to locality, but I have not got the committees entirely made up.

The committee on nomination will be appointed as follows:

Dr. H. M. Smith, of Washington, D. C.

Seymour Bower, of Detroit, Mich.

W. E. Meeham, of Harrisburg, Penn., and

George F. Mathewson, of Enfield, Conn.

The committee on location will consist of Mr. Johnson, Mr. Whish, and Mr. Bowers.

I have not yet selected the auditing committee.

Heretofore, also, there has been a committee appointed on programme, but now that is provided for by the constitution, and the president and the two secretaries are that committee. The corresponding secretary, Mr. Ravenel not being here I took the liberty of appointing Mr. Whish to act for him on the committee, and it might be well for the committee to present the programme at this time.

Mr. Whish: The committee on organization have consulted as to the programme for this meeting, and with this result: We meet at noon for the purpose of organization. After we have duly organized and the preliminary business of the meeting has been adjusted we adjourn to 2:30 sharp, at which time the scientific work of the association will begin.

It has been decided not to have any evening sessions but to give up the evenings to such pleasures as may seem advisable.

Tickets will be provided for the entertainments on the pier and arrangements will be made for a sail on the ocean tomorrow.

The secretary, Mr. Peabody, desires very much to have the names of the gentlemen who want to go on this sail. Some do not want to go, either because they do not like salt water (or any water perhaps), (laughter) or because they want to stay on shore.

The illustrated lectures will be arranged for later, and our second day's meeting will take place tomorrow morning at 9:30 sharp, for the purpose of having this lecture presented in this room. The lecture will be on the subject of Japanese Fisheries, by Dr. Hugh M. Smith of the United States Commission at Washington, and will be illustrated by a series of colored photographic lantern slides.

Two other lectures with slides are on the programme for some convenient time to be hereafter fixed.

The remainder of the time of the sessions will be devoted to scientific matters.

Mr. Titeomb: Allow me to suggest to the committee on programme, that as far as possible papers on any particular subject be grouped together. For illustration, let us have a bass day and a day with the trout or salmon, etc., and in order to carry that out, if papers have not already been grouped I suggest that there be selected from the programme the papers whose subjects are so different from those to which I have referred that they will naturally come in independently. I see for instance that Dr. Bean is here, and he has a paper on the World's Fair and it would come in very appropriately at this time. I make this merely as a suggestion.

President: The programme committee have had those matters under consideration and that is why I would like to hear from the independent papers now and have the bass and trout papers grouped as suggested.

Mr. Titeomb: It is customary at meetings of this character to have resolutions submitted for consideration, and to accomplish that work in the most approved method, I suggest that a committee of three on resolutions be appointed by the chair; and I make the motion, with a proviso, however, that I shall not be a member of the committee. I have a great deal to do outside of the regular meetings and am not well.

Muskoka district, but I should like very much to attend the meeting, and will make the sacrifice this year if possible, unless I am feeling too much under the weather. If I decide to write anything I will adopt your suggestion and furnish a paper on "The License System and How it Works in Ontario."

Yours truly,

S. T. BASTEDO, Deputy Commissioner.

Angler's Association of the St. Lawrence River,

Secretary's Office.

Alexandria Bay, N. Y., June 10, 1904.

George F. Peabody, Secretary, Appleton, Wisconsin:

My Dear Sir:—Your circular letter advising when the annual meeting of the American Fisheries Society will be held was received. As I am just able to be out from a severe illness of catarrhal pneumonia I may not be able to attend the meeting, but will try and have our association represented. We heartily concur in the work of the Society. We are incorporated and the State Fish, Game and Forest Commission is interested with us in the work, and I shall try to have a representative from them. Thanking you for previous courtesies I remain

Sincerely yours,

WILLIAM H. THOMPSON, Secretary.

Waramaug Black Bass Hatchery,

New Preston, Conn., June 15, 1904.

George F. Peabody, Esq., Appleton, Wisconsin:

My Dear Sir:—Your favor duly received. We are again fairly successful, having now on hand 150,000 young bass. Have observed some interesting things in connection with the spawning habits of the bass this season. Had hoped to be able to prepare a paper but am so very busy at the hatchery and no prospect of a let up for a long time, that I fear I cannot find the time. I hope to be able to attend the meeting of the American Fisheries Society in July and relate briefly my experience. Our bass have already given us two distinct spawnings and the third is now in progress. One male gave us 10,861 fry, his second spawning, and am today removing the fry of his third period. This male alone will have given us during the three spawning periods 20,000 fry. Some other males are doing almost as well, while we have four males that have given us nothing. They appear to be unable to fertilize the eggs. So far as I can tell,

these bass were new ones introduced last fall and winter. Our old bass, particularly the males, are among the most productive in the ponds.

Very respectfully,

HENRY W. BEEMAN.

Upper Downing, Holywell, N. Wales, June 17, 1904.

Dear Sir:—In reply to your circular dated the 4th inst., I have much pleasure in stating that though it will be impossible for me to attend the meeting of the American Fisheries Society, which I much regret, I shall have much pleasure in submitting a paper which I trust you will use if you think fit.

We have lately on this side formed a society much on the same lines as the American, called the Salmon and Trout Association, which I hope may do as good work.

Yours sincerely,

J. B. FEILDING.

Groton, N. Y., July 20, 1904.

Mr. George F. Peabody, Atlantic City, N. J.:

Dear Mr. Peabody:—I regret to say that I cannot attend the Atlantic City meeting this time and therefore cannot present the paper I intended. My father died on the 16th and I shall have to be at home most of this month. I wish you all a very profitable meeting.

Truly yours,

M. C. MARSH.

Mr. Evans: As it is absolutely necessary for me to leave the meeting this afternoon it will be impossible for me to serve on the committee on resolutions, and therefore I ask to be relieved.

President: I will appoint Mr. Dennis in place of Mr. Evans on the committee on resolutions.

The secretary then read the following communication:

American Museum of Natural History,

New York, June 9, 1904.

To the Honorable George F. Peabody,

Secretary, American Fisheries Society, Appleton, Wis.

Dear Sir:—The American Museum of Natural History extends a most cordial invitation to the members of the American Fisheries Society to visit the Museum at such time during their thirty-third annual meeting as may suit their convenience.

Very respectfully yours,

H. C. BUMPUS, Director.

Mr. Seymour Bower: I move that we take a recess until 2:30 this afternoon.

Motion seconded and carried.

Meeting called to order at same place, same day, July 26th, 1904, 2:30 p. m., by the president.

The treasurer presented the following report:

To the American Fisheries Society of the United States of America:

Gentlemen:—I herewith submit my annual report as treasurer from July 21, 1903, to July 26, 1904:

1903.		RECEIPTS.	
July 23—Balance in treasury.....	\$ 62.65		
Received from Baird Memorial Fund.....	98.85		
Dues and Admission Fees.....	316.00		
Forty-nine Annual Reports sold.....	12.25		
			\$485.75
		EXPENDITURES.	
			Voucher.
July 23—Expenses, Mr. Brooks to Woods Hole.....	\$ 39.25		1
Aug. 7—500 Stamped Envelopes.....	10.70		2
Sept. 10—H. D. Goodwin, Stenographer.....	158.20		3
Oct. 12—W. O. Liscombe, livery.....	1.00		4
Nov. 14—Judd & Detweiler, Washington, D. C.....	7.00		5
1904.			
Jan. 6—Post Publishing Co., by Secretary.....	\$203.65		6
Jan. 15—500 Stamped Envelopes.....	10.70		7
Jan. 26—G. F. Peabody, Sec'y, Envelopes and Stamps.	45.17		8
Jan. 26—G. F. Peabody, Sec'y, Stenographer.....	25.00		8
June 15—Blank Receipts.....	.75		9
July 20—G. F. Peabody, Sec'y, Circulars and Stamps.	30.83		10
			\$532.25
Balance due treasurer.....	46.50		

Respectfully submitted,

C. W. WILLARD, Treasurer.

Westerly, R. I., July 26, 1904.

Treasurer: I request that this report be referred to an auditing committee.

President: It will be so referred and I will appoint as that committee Messrs. Titcomb, Lane and Palmer.

Secretary: The treasurer and myself have in charge the matter of receiving and expending the funds of the society, and at the present rate of dues, one dollar, and the present price for extra copies of the reports, 25 cents each, we are falling behind. We had hoped that we could carry the business on the basis of one dollar for membership and dues, but we find that we are paying more money for our books than we get back. For example, the reports cost about 50 cents a piece, and the rule of the society is that they shall be sold at 25 cents each for additional copies, and members each receive one copy free. The matter is now so pressing that it seems very much as though we should increase the dues for next year (not this year). This year I have distributed a large number of copies of the transactions at 25 cents each, and a large number gratis, and I would recommend that the society raise the dues to \$2, commencing with next year, and that the price of extra copies of the reports be raised to 50 cents, and I offer that as a resolution.

Mr. Willard: Do we understand that you wish the price of the books to go into effect one year from now or at the present time?

Secretary: We have only a dozen to sell at the present time.

Mr. Willard: As treasurer of the association I have made an extra effort during the past year to collect in the dues. I have written personal letters to a great many members who have been in arrears, and I think I have collected as close as anybody could. In January last I was obliged to advance to the society to meet maturing obligations, about \$100. Of course this has been somewhat made up in the meantime as my report shows, bringing the deficit down to \$46.50; but we have been helped in bringing this down by quite a number of membership fees from new members coming in for this present year. Being conversant with the finances of the association I should agree with Mr. Peabody, that at least after a year from now our dues should be advanced to at least \$1.50 or \$2.00. I desire to second Mr. Peabody's resolution.

President: The resolution is that after this year the dues be fixed at \$2.00 a year. Now it would be proper at this time to take up that question, and I trust there will be a free and full discussion of it.

Mr. Meehan: I would like to ask the treasurer what is the number of members who have not paid up? That will give us some clue as to what the natural deficit should be.

Mr. Willard: Our present membership is about 375; there are 37 members who owe for the 1903 dues, there are 35 members who owe for the 1903 and 1902 dues and there are 8 members who owe for 1901, 1902 and 1903 dues. I have sent out at least three notices to each of these members and to quite a number of them I have written personal letters, explaining to them the cost the society had been put to to get out the reports, etc., and urging them to pay up their dues and remain members or express their desires if they wished to have their names dropped and in numbers of instances I have had no response whatever.

Mr. Meehan: It appears from the statement of the treasurer that even if the annual dues of all members were paid up there would still be a deficit; that is at \$1.00 a year the dues would not cover expenses. Is that correct Mr. Treasurer—the natural dues of this association will not pay the natural running expenses.

Mr. Willard: That is a fact.

Mr. Meehan: Then there is only one thing to do, viz, to raise the dues.

Mr. Willard: One thing that has helped us out this year was the \$30.00 or \$40.00 turned over by the Baird Memorial Fund Committee. There is no question in my mind but that with the dues at \$1.00 per year we will again fall behind, and the treasurer will again have to advance the money.

President: It is a good thing we have a good treasurer. (Applause.)

Mr. Titcomb: I wish to support the resolution. I was present at Woods Hole, I believe, when the dues were reduced

to \$1.00, and a great many of us thought it was a mistake, as it has proven to be, at least from a financial point of view.

Some one asked me just before lunch about the matter of life membership, and I was just looking over the constitution to ascertain what right we had to change these dues at a meeting of this character, and I see we can change the constitution by a two-thirds vote, when fifteen members are present, and in connection with that I will say that there is a provision here whereby any person may upon a two-thirds vote and a payment of \$15.00, become a life member of this association and thereafter be exempt from all annual dues. Possibly there are members enough here who would like to take advantage under the circumstances of this life membership clause, to materially reduce the deficit. Fifteen dollars is a low price for a life membership in this association.

(The following members thereupon, in accordance with Mr. Titcomb's suggestion, announced that they would subscribe for a life membership in the association.)

Mr. Meehan.

Mr. Douredoure.

Mr. Titcomb.

Superintendents of hatcheries.

(Per Mr. Buller.)

Mr. Seymour Bower: In explanation of the reduction of the dues at Omaha, I would say that the dues had been \$3.00 a year, and under that rate the membership dwindled to a mere handful, and the question of increasing membership by lessening dues then arose. I favored \$2.00, but the \$1.00 men won out. Three dollars perhaps was too high—\$1.00 is plainly not sufficient—and I therefore support the motion to make the dues \$2.00.

President: I was at the meeting that Mr. Bower speaks of, and I fought, bled and died for \$3.00—I really died—he killed me. (Laughter.) In fact that was the only question that I ever did agree on with our friend that has gone. (Mr. Whittaker.) We tried to keep the dues up to \$3.00, and we prophesied at that time that the society would face a deficit if the dues were reduced

to \$1.00. However the society might have died under the other plan, and the proceedings of this meeting as printed by the secretary are alone worth all the dues that we are now assuming.

Mr. Buller: The superintendents of our hatcheries will apply for life membership. (Applause.)

President: I think if the dues are raised to \$2.00 the price of the life membership ought to be raised.

Secretary: I move an amendment to the constitution striking out the amount stated in article 2 of \$1.00 per year and inserting \$2.00 in lieu thereof, so that it will read:

"Any person shall, upon a two-thirds vote and a payment of \$2.00, become a member of this society. In case members do not pay their dues, which shall be \$2.00 per 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 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."

Regarding the price of extra copies of proceedings, there is nothing in the constitution that would have to be changed by the society.

Motion to adopt resolution made and seconded.

Unanimously carried.

President: Now I would like to offer a resolution and move its adoption, that the price of the reports be raised from 25 cents to 50 cents to take effect now.

Motion seconded.

Mr. Titcomb: What do the reports cost us?

Secretary: About 50 cents, including stenographer's expenses.

Motion seconded and unanimously carried.

Mr. Milligan: What are we going to do about that deficiency? We have a habit in the navy of taking up a collection under such circumstances. I think it would be a good idea to pass the hat.

Mr. Meehan: Is the society incorporated under the laws of any state?

President: I think not.

Mr. Meehan: If the society is not incorporated we are all liable individually—we had better pass the hat.

Mr. George F. Peabody of Appleton, then read a paper entitled "A Tribute to Hon. E. E. Bryant."

In the absence of Mr. M. C. Marsh, his paper on the subject of "Danger in Shipping Cans, Notes of an Experiment Made at the Cold Springs Harbor Hatchery of the New York Forest, Fish and Game Commission, was filed without reading.

Hon. Tarleton H. Bean then read a paper entitled, "Fish and Game Department of the Universal Exposition at St. Louis."

Mr. E. N. Carter read a paper entitled, "Notes on Sturgeon Culture in Vermont."

Dr. James A. Henshall then read a paper entitled, "Feeding Fry."

Mr. W. E. Meehan, then read a paper entitled, "A Year's Work of the Fisheries Interest in Pennsylvania."

A recess was taken until next day, July 27, 1904, 9:30 a. m., same place.

Wednesday, July 27, 1904.

July 27, 1904, 9:30 a. m., convention called to order by the president.

Mr. Douredoure: I rise to ask whether it would be in order to offer a resolution that the chair appoint a committee to prepare articles of incorporation and secure a charter. I do this

supposing that we are not a chartered organization. I am very strongly of the opinion that we should be chartered. I would like to take the sense of the meeting as to that, and so I offer the resolution that the chair may appoint a committee to prepare articles of incorporation, and secure a charter, and move its adoption.

Motion seconded.

Mr. Dennis: I should be very glad to prepare your articles without charge and make them applicable to any state in the union.

Mr. Root: I just wish to ask for information, if we got a charter would it require a location and place of business, an office and a meeting at a particular point? We are a sort of a peripatetic organization, having no state headquarters, and I suppose these legal gentlemen can tell whether we can obtain a charter for a moving body such as we are. I presume we can.

Mr. Douredoure: I cannot tell. I am not a lawyer—I am a poor merchant.

Mr. Joslin: What is the precise question?

President: The precise question is can we be a legally organized body with a charter and not have a legal place of business or office?

Mr. Joslin: I can only answer for a few of the states in which I have had occasion to examine the laws, but generally speaking the laws of the different states require that we shall have a principal place of business, and at least one annual meeting there, and I would think that at least when you wanted to amend your constitution or by-laws you would have to go to that particular place to do it. I wish you to understand however that an insurance policy does not go with this opinion.

Mr. Dennis: It is required by every state that I have had any connection with, in the securing of a charter, that the principal place of business shall be in a city in that state, but under the laws of Delaware you can get a charter and a company there will maintain an office for you and you can have your principal

place of business wherever you please. And that is the reason why so many corporations go to Delaware to get their charters. In my own state for instance, we would have to have the principal office there, if incorporated under the laws of Maryland; but an organization of this sort could get a charter in Delaware and have their meetings wherever they please.

Mr. Joslin: Also in this state, Connecticut and quite a number of states.

Mr. Dennis: Yes, but I selected Delaware because they are more liberal there than in other states.

Mr. Joslin took the chair.

Mr. Clark: The American Fisheries Society has gone along unincorporated for 33 years. I have been a member 27 years, and Dr. Bean perhaps longer, and it has seemed to be necessary here all at once that we be an organized body. Why? That is what I would like to know. I would make a suggestion, or possibly an amendment to the motion, that instead of the 3 members of the committee being appointed by the chair to do this, that the three be appointed to report at our afternoon session on the question of the advisability of organizing.

Mr. Douredoure: I will accept the amendment.

President: (Mr. Joslin in chair.) The amendment is that a committee be appointed to report at the afternoon session, or some other session of this body, on the advisability of incorporating. The mover of the first motion accepts the amendment so the question is now upon this amendment of Mr. Clark.

Mr. Root: When matters are referred to a committee and they report, almost invariably the meeting feels called upon to support the report of that committee. Now I do not want them to report in favor of a charter; I do not believe we need it; I think we are getting too high toned. I would rather see us go on the way we have been going on for years and years. I hope we are not afraid of being assessed to pay our treasurer. (Laughter) I do not see the necessity of having a charter; it involves considerable trouble and expense. I think the matter

better be discussed and decided right here, or else ignore the report of the committee when it comes in (laughter), that is, be not bound by their opinion either way, so that it can be open for discussion on the report of the committee.

President: (Mr. Joslin) The society would not be bound by the report of the committee until the report is adopted.

Mr. Root: Usually they feel under obligations to a committee that reports, to carry out the recommendations of the committee.

Motion carried.

President Clark in chair: The chair will appoint five on the committee and will take some time to select them.

Mr. Douredoure: The resolution left the number on the committee to the discretion of the chairman.

Secretary: Dr. Johnson of Boston has collated a book that is most interesting on the subject of fish and contributions have been made by distinguished men, Dr. Henshall among others, and this book is an edition de luxe of very large expense, and Dr. Johnson has kindly brought copies of it here and they will be on exhibition in the sideroom after this meeting, and this evening and tomorrow. It is a book that I understand has cost over \$10,000 to print, and the society have the opportunity of looking it over, and if any choose to purchase it I believe it can be purchased at the actual cost of publication, independent of the large original expense attendant upon securing and arranging the material.

President: We will now hear the report of the committee on time and place of meeting.

Mr. Joslin: The time and place have been agreed upon. I am going to apologize for saying a word which I think devolves upon me to say. It is rather embarrassing to me to be placed upon the committee at all, and more particularly to be made chairman, for this reason: the city of Grand Rapids in my own state desired very much to have this society meet there, and the members of the society from Michigan, myself among the num-

ber, were charged with the duty of bringing it there. Now to put me on as chairman of the committee, and then afterwards compel me to report in favor of another place is embarrassing. I think I am privileged to say however, that whenever this society sees fit to go to Grand Rapids it will never regret having gone there. I think we have more people interested in protecting game and fish in that section of the state of Michigan than in other quarter of the United States of the same area; so that, at some future time, if I am present, I shall expect to get the vote of this society for Grand Rapids. In the meantime however, your committee have unanimously agreed upon White Sulphur Springs, West Virginia, as the place.

As to the time of meeting, we were unable to get a calendar of next year, so we fixed the time as the last week in July, that being on the whole the time when superintendents and others engaged in fish culture have the least to do and can best spare the time to attend the meeting.

I move the adoption of the report.

Motion seconded and unanimously carried and report adopted.

The secretary then read a paper by Mr. S. W. Downing of Put-in-Bay, O., on the subject of "The White Fish," some thoughts on its propagation and protection.

President: That paper is very interesting, and probably I am more interested in it than many others, although all of the state commissioners are interested. As Dr. Smith is now ready for the illustrated lecture we will defer the discussion of Mr. Downing's paper until this afternoon, and I trust the gentlemen will remember the paper, and what it is and what they want to bring out.

I will appoint as the committee on necessity of organization, Mr. Joslin and Mr. Dennis, two legal gentlemen, Dr. Bean, Mr. Douredore and Mr. Root, and I trust that committee will go over the matter very thoroughly, canvassing the ins and outs, and give us a report that will be all right.

Dr. Hugh M. Smith of the United States Fish Commission, Washington, D. C., then delivered a lecture illustrated with lantern slides, on Japan, the Paramount Fishing Nation.

A recess was here taken until 2 p. m., same day and same place.

AFTERNOON SESSION.

Wednesday, July 27th, 1904, 2:30 p. m., meeting called to order by the president.

President: We will now listen to the report of the auditing committee.

Mr. Titcomb: Your auditing committee have to say that we have examined the vouchers of the treasurer which correspond to the statements made by him, and have found everything correct. Signed by the full committee.

Report of committee received and placed on file.

Secretary: I have just received a letter from Mr. Ravenel, our corresponding secretary, and he says:

"I regret to say that there is little prospect of my being able to get to Atlantic City even for a day, as I must go to St. Louis. Please report to the society for me, stating that I have attended to all correspondence as corresponding secretary, referred to this office.

Dr. Bean: This World's Fair literature which is placed on the chairs was sent here for distribution among the members of the society, and includes a map of the grounds and some other interesting material.

Secretary: I have a letter from one of our members, Mr. Daniel B. Fearing, of Newport, R. I., who wishes to secure the first 5th and 8th volumes of the transactions of the American Fisheries Society to complete his set, and he will give any price in reason for them. If any of the members having these numbers which they wish to dispose of will communicate with me I will arrange for the transfer.

President: It has been suggested that this afternoon will be a good time to take up the bass papers and if there is no objection we will proceed upon that line.

Mr. Lydell: How about the opportunity to discuss the Whitefish paper?

President: That is true. The paper by Mr. Downing, the Whitefish paper, is open for discussion.

Mr. Downing said a good many things there is a great chance for discussion if the gentlemen wish to discuss them. If there is nothing to be said on it however, we will take up the bass subject.

Mr. J. L. Leary, Superintendent of San Marcos, Texas, station, then read a paper on the subject of Construction of Ponds and Pond Cultural Methods.

President: Gentlemen, I think perhaps it would be better to have a discussion on each paper as it comes up. The paper is open for discussion now. No doubt many of you have ideas on the construction of ponds for black bass and other fishes that would be interesting for us to know.

Mr. Titcomb: Would not that paper of Mr. Lambert's on Bass Pond Construction come in well there—it is very short.

President: We will have Mr. Lambert's paper and it will be read by Mr. Titcomb.

Mr. Titcomb then read a paper on the subject of a Plan for Bass Pond, by E. M. Lambert.

Mr. Seymour Bower then read a paper by Mr. Dwight Lydell on the subject of Some notes in Connection with the Bass work at Mill Creek station.

President: Our secretary has a matter that he would like to bring before the meeting in connection with Dr. Smith's illustrated lecture.

Mr. Peabody: A number of members of the society have suggested to me the advisability of publishing this very valuable contribution of Dr. Smith's, in the coming report, with the illus-

trations. This involves an increased expense to our already overdrawn treasury for this year, and we shall need probably to carry out this idea, some \$50 or \$60, and I would like to ask the co-operation of the meeting in this matter, and I would suggest that any here who feel able to contribute might call out the amount of their contributions and have it taken down, and I might, if there is a deficiency, send out a few notices to some friends of the society who I know would respond with enough to make up whatever deficiency there is. If it is your pleasure, gentlemen, and there are no objections, I would ask that any here who feel able to make a contribution to please announce it and let it be taken down now.

President: Just stop for one moment and try to realize what this will mean for our proceedings, to have that lecture printed with illustrations. I think you will have a book there that you will never want to sell very cheaply, and it seems to me that the idea of a contribution is a very good one. Of course our treasurer will hardly stand all of it (laughter) and I hope the idea of Mr. Peabody's will be carried out.

The following contributions were then made:

Mr. Peabody \$5, Mr. Lydell \$1, Mr. Meehan \$2, Mr. Wires \$2, Mr. Seymour Bower \$1, Mr. Leary \$1, N. R. Buller \$1, Mr. Wallich \$1, Mr. O'Malley \$1, Rhode Island Commission \$5, William Buller \$1, H. M. Buller \$1, A. G. Buller \$1, Mr. Lambson \$1, Mr. Ward Bower \$1, Mr. Douredoure \$2.

Mr. Johnson of Manchester, Iowa, \$1; Mr. Seagle \$1; Mr. Mathewson \$1; Mr. Stone \$1; Mr. Hubbard \$1; Mr. Lane \$1; Mr. Downing \$1; Mr. Dean \$1; Mr. Slade \$1; Mr. George M. Brown \$1; Mr. Joslin \$1; Dr. Johnson \$1; Mr. Robinson \$1; Dr. Henshall \$1; Mr. Townsend \$1; Mr. Clark \$1; Mr. S. G. Worth \$1; M. Booth \$1; Mr. Locke \$1; Mr. Jones \$1; Mr. Dinsmore \$1; Dr. Bean \$1; Mr. Whish \$2.

President: I think when you get the proceedings published in **that form** it will be something you would not take \$5 for.

We will listen to the report of the committee on nomination of officers.

Dr. Smith: The committee has the honor to report and does report unanimously as follows:

In selecting the names of the members whom we desire the society to consider as officers for the next year, we have been guided by two general points, first, we recommend no one who is not present at this meeting, second, we have endeavored to distribute our little favors as much as possible among the states, so that among the five officers and seven members of the executive committee whom we shall present to you, eleven states are represented.

We have great pleasure in suggesting for president of the society a gentleman who has been a very faithful member whom we think you will be more than gratified to honor in this way, Mr. Henry T. Root, of Providence, R. I. (Great Applause.)

For vice-president we recommend and nominate Mr. C. D. Joslin, of Detroit, Michigan. (Great Applause.)

For recording secretary we have not considered it advisable to make any change and we submit to you again the name of Mr. George F. Peabody, of Appleton, Wis. (Applause.)

For corresponding secretary we name Mr. Charles G. Atkins, of East Orland, Me. (Applause.)

We think that the gentleman who advances \$100 every now and then out of his own pocket to run this society, is certainly entitled to recognition, and we name for treasurer Mr. C. W. Willard, of Westerly, R. I. (Great Applause.)

The members of the executive committee whom the nominating committee have chosen are Mr. Wm. E. Meehan, Chairman, Harrisburg, Pa., and the other members are Mr. John D. Whish, Albany, N. Y.; Mr. E. H. Geer, Hadlyme, Conn.; Dr. James A. Henshall, Bozeman, Montana; Mr. G. H. Lambson, Baird, Cal.; Mr. J. J. Stranahan, Bullochville, Ga.; and Mr. H. M. Smith, District of Columbia.

Mr. Meehan and Mr. Smith are members of the nominating committee, and they are put on the executive committee because they were outvoted. (Applause.)

Mr. Titcomb: I move that the report be accepted and adopted and the secretary be instructed to cast the ballot for the election of these officers.

Motion seconded and unanimously carried, ballot so cast and officers declared duly elected.

President: I want to introduce to you our worthy friend and president—to be—after this meeting, Mr. Root of Rhode Island. (Great Applause.)

Mr. Root: Gentlemen, I think there are a great many here, if Mr. Clark had not pulled me up, who would not have known who Henry T. Root was. (Noises—Not much.)

Mr. Root: I will say that I was informed through one of our leading men on my first arrival here that my name would probably be mentioned in connection with the office of president. I tried to dissuade him from using it. I really felt that I was not the proper person to preside. I do not know personally a great many who are members of the society, and another thing, I have arrived at the allotted age of three score years and ten and think that the burdens of life should be taken easily; though I do not think this is a very burdensome office. Another thing, years ago I got tired of hearing declamations when I was a member of a good many societies, and I think it is a very poor policy, and I concluded that if I was ever nominated for an office I would not decline, and if the people who nominated me had made a mistake I would throw it back upon them. Now while I think that you could have done better, and while I know that you have paid a compliment not to me, but to Rhode Island, in that light I accept the position, knowing that it is a compliment to Rhode Island, with a great deal of pleasure. (Applause.)

President: I take great pleasure in introducing our newly elected vice-president. We know him out there in Michigan, and before you get through with him you will know him.

Mr. Joslin: I really do not know what to say. This is a great surprise. I am practically a new man among you, although perhaps not new in the business in a sense, but I want to say to you that to be elected to an office of this kind in such a society as this is certainly an honor which I thoroughly appreciate, and I thank you most sincerely that you have taken it into your heads to do a thing of this kind. All I can say further is

this, that having taken it upon myself to attend the meetings of this society, I shall continue to do so as long as I live and have my health, and I will meet you all, or as many of you as will meet me, every year from this on, not because you have seen fit to honor me, but because I think it is a good place to be, because there are a lot of good men here and a lot of good fishermen and a lot of men who are engaged, at least as I think, in a work higher than perhaps you have all thought, in a work of education—and let me say what I mean by that in a word or two if I can. A few years ago I was trout fishing on a river which is pretty well known in the west and by a great many fishermen in the east, the Au Sable River in Michigan. A number of men had camped down below where I was encamped, had fished there for a week or ten days, and when they started for home six or eight men undertook to carry back to their homes over 3000 brook trout. Every one of you here knows that such a feat as that cannot be accomplished. They lost the most of their brook trout, but that was not all; they belonged to the genus homo that I have dubbed for the last 25 years as the fish hog. At that time we had no restrictive laws with reference to taking away from the stream any number of fish, but such incidents as that have been discussed from time to time, and each man would tell his neighbor, until the state of Michigan almost voluntarily, without any instruction from its fish commission, or even the sportsmen of the state, passed a law limiting the size of the trout which could be taken, and the number which could be taken away from the stream though you stayed by it all summer.

Now the work of you gentlemen here has been to educate the business man so that when he goes out fishing he does not continue his business. That is to say, when he is at home in his office he is engaged in piling one dollar on top of another; when he gets out into the woods he rarely becomes a sportsman at first; he simply changes the things that he is piling top of one another, and he piles trout instead of dollars! Well, after a few years of association with men like you, he discovers what he goes into the woods and along the streams for, viz., to change the current of his thoughts and to change the current of his blood, and to make a new man out of him, and he finds that if all he wants in

the world is to get fish, the better way is to stay at home and go to the market and buy them; if he wants to get a new life, and look upon life in a different way; if he wants to get—what is it, doctor the uric acid?

Dr. Johnson: The uric acid. (Laughter.)

Mr. Joslin: If he wants to get the uric acid out of his blood, let him go into the woods and see the beauty that is around him; and perhaps each day that he stays in the woods let him fish an hour or two hours, and then he returns home himself an educator, himself a protector of the game and of the fish. Now I take it that that is the life work which you gentlemen are really engaged in. You are educating the people to know that they have all around them the means of subsistence, the means of pleasure, which will last forever if they will only protect it.

Gentlemen, I thank you again for the honor which you have conferred upon me. (Great applause.)

President: I want to assure Mr. Root that the burdens of the office are not very heavy, (until of course you get here and then for a day or two there is something to do) for the reason that you have a secretary and treasurer who do all the work—just shift your burdens on them. (Laughter.)

Mr. Meehan: I would like to offer a resolution bearing somewhat on the business we have just had in hand, and it is as follows: Resolved that there be appointed by the chair a standing committee of five on foreign relations, one member of which shall be the corresponding secretary of the society, whose duty it shall be to keep informed on the progress of fish culture, fish protection, and general fishery work in foreign countries, and to make reports to the society at each annual meeting.

Further resolved that the corresponding secretary be the chairman of this committee, and that he be authorized and requested to enter into and maintain close relations with the leading fishery authorities of other countries.

Mr. Peabody: I support the resolution and move that it be referred to the committee on resolutions.

President: It will be so referred.

Mr. Samuel Lovejoy of Bullochville, Georgia, presented a paper on the subject of What I have seen of Black Bass.

The secretary then read a paper by Mr. Green on the value of aquatic plants.

Mr. Titcomb took the chair.

Mr. Charles G. Atkins then read a paper entitled The Utilization of Neglected Fishes.

President: We have tomorrow five papers to be presented from members that are here, and two of them are illustrated, and if it is the pleasure of the society they will be given in the forenoon and then we will try to finish up in the afternoon.

Mr. Joslin: I wish to make a committee report at this time, of the committee on resolutions, in regard to organizing.

The committee met directly after the meeting of this body this morning, including the mover of the resolution, and after some discussion in which all the members of the committee participated, we unanimously agreed that the organization was not desirable, for one reason in particular, and that is, that it would require at least one meeting a year of the society in some named place in the articles of association, and as we meet only once a year it would practically destroy the society itself; and therefore the committee unanimously report that the resolution be not adopted, and that we do not organize under any charter or any laws of any state.

I move the adoption of the report.

Seconded and unanimously carried.

Adjourned to 9:30 a. m. sharp, the next day.

Thursday, July 28, 1904.

Same place, July 28th, 9:45 a. m. meeting called to order by the president.

The president called for the report of the committee on classification of bass.

Mr. Seymour Bower: The committee as a whole is not prepared to make a report. But so far as my personal views are concerned, as to the grading of bass, I stated them yesterday. I would divide the fish into fry, advanced fry, baby fingerlings and fingerling. Advanced fry are fish up to an inch and a quarter in length; baby fingerlings from one and one quarter to two inches; or instead of baby fingerlings they might be called small fingerlings or half fingerlings, whichever term you prefer to use; and fingerlings from two inches up.

President: I heartily agree with Mr. Bower on this matter; but a short time ago I had a letter from Mr. Ravenel, the other member of this committee, and he said he would like to have Mr. Bower and me give him our views and he would then express himself. So I think the matter had better be deferred until next year, and the committee no doubt will make a full report at that time.

Dr. F. M. Johnson of Boston, Mass., then gave a resume of work that he has been doing during the past year in the raising of western charr in eastern waters.

Dr. Smith: I desire to bring up a little matter that is not wholly disconnected with the subject that has just been discussed. This work on fish diseases to which Mr. Whish has referred marks an epoch in fish culture, and the author of it Prof. Dr. Bruno Hofer of Munich, is very prominent in fish cultural and other fishery work in Germany, and I think it would be eminently proper for this society to elect him an honorary member, and I propose that we take that action. While on the subject of honorary members there are two or three other foreigners, prominent in their different lines, whose names I would also like to recommend for this purpose.

Mr. Charles E. Fryer, supervising inspector of fisheries, Board of Agriculture and Fisheries, 3 Delahay St., London, England.

Dr. J. Lawrence-Hamilton, M. R. C. S., 30 Sussex Square, Brighton, England, who is doing admirable work for the development of the fisheries of his country.

Prof. S. Matsubara, President, Imperial Fisheries Institute, Tokyo, Japan, and Dr. K. Kishenonye, Imperial Fisheries Bureau, Tokyo, Japan.

The gentlemen were unanimously elected honorary members of the association.

Dr. Smith: I ask that the secretary notify them of their election.

President: That will be done.

Mr. S. G. Worth then read a paper entitled the Recent Hatching of Striped Bass, and Possibilities with Other Commercial Species.

Dr. Johnson: I would like to propose as an honorary member, Lord Denbigh, Col. of the Honorable Artillery Company, London, England. He has been doing the same work in London that I have been trying to do here. He has put the rainbow trout in all the parliament ponds; he is a true sportsman and an enthusiastic gentleman.

Carried and so done.

Mr. Titcomb: It seems to me that this meeting has got so far along that we can safely do it, and I therefore propose a vote of thanks to the retiring officers for their efficient services, as a result of which we have had such a successful meeting this year.

Motion seconded, put by Mr. Titcomb, and unanimously carried.

Dr. Smith presented H. F. Moore's paper on the subject of Progress of Experiments in Sponge Culture.

President: We will take up Mr. Dinsmore's paper. He will give us a short synopsis of his lecture.

Mr. Dinsmore: Mr. President and Gentlemen of the society: The particular condition of affairs which exists makes it pertinent to ask the question, who is getting the best of it at this time? I escape the difficulty of talking to you and you escape the difficulty of listening to me. I regret that I am unable to show you the pictures which I had brought here, obtained through one of the most interesting experiences which has ever come to me in my connection with the work of the United States Fish Commission, that of collecting black spotted trout eggs in Yellowstone Park. Doubtless many of you are familiar with the wonderful character of that country, with its geysers, its hot springs, its remarkable canons and its great lake and river systems. When the president came to me and asked me what I would do in relation to my paper, in consideration of the fact that we could not have the lantern, I thought I would read you some portions of my paper referring particularly to fish, but I think I had better not do it. It is getting late, you are doubtless somewhat wearied, and I just wish to say that I will try and be at your meeting next year, and if you care to listen to me at that time, and see the pictures which I was able to secure, I will be very glad to show them to you.

President: I want at this time to say that the Hon. George M. Bowers has been with us all the time. He has not taken any part in the meeting but he has been with us heart and soul I know, and we want to hear a word from him.

Mr. Bowers: Mr. Chairman and fellow members of the American Fisheries Society, when I left Washington I resolved not to participate in the discussions that we might have on this occasion. I did that for fear that some people might misconstrue and accept as official any statement that I might make, but having witnessed this the most important meeting to my mind, of our society, I cannot refrain from expressing my gratitude and my appreciation to each and every one of you for the interest you have manifested on this occasion.

On behalf of the Bureau of Fisheries as well as the society, I wish to congratulate our worthy president upon the magnificent manner in which he has presided. He has proven to be one of

the most successful of parliamentarians, and I am certain a most excellent disciplinarian. (Applause.)

So many encomiums have been passed upon the secretary from time to time that I am sure what I have said about the president applies also to him, (Applause) and under the circumstances I hardly think it is necessary to throw additional bouquets at him. I do not feel that it should fall upon me to deliver the benediction if this is the wind up and the finish, but I desire to present further too for your consideration, a hope that it maybe the pleasure of this society to elect Hon. Victor H. Metcalf, the present secretary of the Department of Commerce and Labor, as an honorary member.

I thank you gentlemen for your attention. (Applause.)

Mr. Victor H. Metcalf was then unanimously elected honorary member of the society.

Mr. Bowers: I deeply appreciate the fact that you selected White Sulphur Springs as the place of meeting for next year. I say this as a West Virginian. I hope that every individual present, may on that occasion come down into the mountains of that little mountain state, and I assure you that you will find some of that old time, genuine southern hospitality, for which we at least, to some extent have created the impression throughout the country that we can have and give; we want every member here, his friends, uncles, aunts and cousins to come down to White Sulphur Springs next year. (Applause.)

President: Gentlemen of the American Fisheries Society, I do not know but what it would be proper for me at this time to say a word or two, as our honorable commissioner and ex-president of this society has been so kind as to say what he did, throwing bouquets, etc.

I have not tried, gentlemen, to distinguish myself at all. One year ago when you elected me president of this society, I certainly considered it a very high honor, and I cannot help but feel still more that it is a very high honor indeed to have been president of the American Fisheries society. Gentlemen, our meeting at Woods Hole was certainly a grand one, and you will perhaps remember in my short talk at the opening of the meet-

ing, I asked if we could not make this still better. I do not want to say that it has been made better, but it does seem to me that it has been a grand meeting. Here it is almost impossible to close up our work in three days. I, as well undoubtedly as some of the older members, Dr. Henshall, Dr. Bean and some others, can remember the time when we had a hard job to keep the thing going one day, and we had to meet a little while and adjourn, but we cannot find time to have any fun here, and I predict in the very near future we will certainly have to have four days session instead of three. Our membership is growing and the American Fisheries Society is certainly growing, and I appreciate it greatly to think I have had the pleasure, and it has been a pleasure, of presiding at this meeting. I hope I have done fairly well and I now, after the adjournment of this meeting will take pleasure in stepping down on the floor with the ex's and try to have some fun in the argument. The only thing here that has bothered me has been to keep my chair. It has been impossible for me to do so all the time, as you have seen, but I should have liked to take part in the argument and discussion of every paper. I thank you gentlemen.

Mr. Titcomb: I do not know but what I am going to take up a lot of time, if you take the question up, but there is a standing committee that has not been discharged, on the question of the size of fish, and what they shall be called, fry, fingerlings, yearlings, etc.

President: The two members of the committee that were here, had a little talk (Mr. Seymour Bower and the President) and I suggested that we ask that the committee be continued and report next year because Mr. Ravenel had written me that he would like to hear from Mr. Bower and me, and then he would give his views. He did not ask us to close the matter up. I would therefore ask that this committee be continued.

President: It has occurred to me all through this meeting, because the reporters have run to me and run to the secretary, treasurer, and the individual members, that this society should have in the future, some one to act as a press secretary. Our newspapers do not get the report as they should. They give altogether too much of one thing and not enough of another. Now

I think that is a matter that we should take up at our next meeting, to have some one act as a press secretary. If we could have some of our newspaper men do that it would be advantageous; because I tell the reporters something, Mr. Peabody does the same, and they do not get it as they should. I trust members will take that matter under consideration and provide for it.

Mr. Titcomb: I move that the incoming president and secretary be authorized to appoint and arrange for a press secretary.

Motion seconded and carried.

President: The committee on foreign relations are Mr. Atkins, chairman; Mr. Titcomb, Dr. H. M. Smith, Dr. Henshall and Dr. Johnson.

The report on resolutions was read by the secretary as follows:

Resolved, that the Society acknowledges with the deepest appreciation and thanks, the courtesy extended by Mr. James R. Keenan for the delightful meeting place provided by him for the meeting of the society, and to Mr. Young for the freedom of his pier, and the many courtesies extended during the social hours of the society.

Resolved, that the secretary be directed to send a copy of these resolutions to Mr. Keenan and to Mr. Young.

Whereas, the awful and final reaper has come into the midst of the society and removed therefrom Dr. E. Bradley, Dr. Bushrod W. James, Mr. S. L. Griffith and Gen. E. E. Bryant.

Therefore be it resolved by the society that the families of these members be assured of our heartfelt sympathy, and that this resolution be spread on the minutes of the society as a special mark of respect and sympathy, and that a copy hereof be sent by the secretary to the members of the respective families of the deceased.

Be it resolved by the American Fisheries Society in meeting assembled, that the society views with great interest the activity in the fish culture field of action, the splendid work being done,

and the aid given by the *American Fish Culturist* edited by Mr. E. N. Carter, and the *Fishing Gazette* edited by Mr. G. E. Jennings, and we heartily recommend and endorse both of these publications to the membership of this society.

The committee on resolutions suggest to the society that the admirable paper on the life of the late lamented General E. E. Bryant, prepared and read by the secretary, Mr. George F. Peabody, be spread on the minutes as a fitting tribute and memorial to General Bryant.

The foregoing resolutions were unanimously adopted and the society then adjourned sine die.

PART II.

SCIENTIFIC PROCEEDINGS.



A Tribute to Hon. E. E. Bryant

BY GEORGE F. PEABODY, APPLETON, WIS.

Mr. Peabody: (Before reading paper.) The older members of the society who have been in the habit of attending the meetings, are familiar with the cheery personality of Gen. Bryant. Those who have not had the pleasure and opportunity may learn something from what may be said regarding him, of his life and character.

I have been asked by the President, and the executive committee, because of my long acquaintance, to say a few words in memory of our late President and active member, General E. E. Bryant of Wisconsin.

I wish that I were better fitted to perform this duty, and that I were better able to choose fitting words to express my sorrow and grief for the loss of such a friend, and my admiration for his admirable qualities.

A year ago we parted at Providence with one who had endeared himself to every member of the American Fisheries Society with whom he had come in contact.

General Bryant left us to go to his old home in Vermont for a brief visit, was taken ill, recovered sufficiently to accompany home his son-in-law (a physician) who came on from Wisconsin to care for him. The General died suddenly and peacefully in a sleeping-car between Toronto and Chicago.

As President of the Wisconsin Fish Commission, his interest in fish culture and encouragement had advanced the commission and its work to the highest rank.

So interested was the General in the work of the American Fisheries Society that he attended regularly every meeting, urging the other members of the commission to attend.

Resolutions adopted by the Rhode Island Fish Commission:
Providence, R. I., Sept. 10, 1903.

At the regular meeting of the Commissioners of Inland Fish-

eries of Rhode Island held this tenth day of September, 1903, the attention of the commissioners was called to the fact of the death of General E. E. Bryant on the tenth day of August, A. D. 1903, it was unanimously resolved that the following minute be spread on our records and that a copy of the same be sent to the family of the late General E. E. Bryant.

We knew General E. E. Bryant from an acquaintance formed at four annual meetings of the American Fisheries Society. We regarded him as easily the peer of any of the members of that society of able men.

We learned to regard him as a personal friend.

We loved him.

The different associations and societies of which he was a member must feel that they have lost a strong man.

Words are inadequate to express our heartfelt sympathy for his family which we hereby extend, in this their great bereavement.

HENRY T. ROOT, President.

WILLIAM P. MORTON, Secretary.

In my years of close association with the General I had grown to love him, as did all who came in contact with his simple kindly nature. There was no bitterness in his soul, cheerful always. His never failing humor lightened every hour spent in his company.

I cannot do better in speaking of the General than to draw from the eulogy paid General Bryant by ex-Senator and ex-Postmaster General William F. Vilas, at a memorial service held at the Fuller opera house, Madison, Wis., last May, nearly a year after his death. All that was then said I would say, aye, more of my dear friend.

Here in the presence of a thousand people who had gathered to do honor to General Bryant, his former law partner and neighbor for thirty years, Senator Vilas, paid a tribute of which few men are worthy. I shall make a few extracts from this eulogy, one of the truest, finest, and most beautiful tributes ever paid a worthy man.

In the Fuller opera house Sunday afternoon, May 29, 1904, Senator William F. Vilas paid a beautiful and appreciative tribute to his intimate friend of thirty years, the late General E. E.

Bryant. The auditorium was filled, and the tender yet eloquent eulogy was followed with a sympathetic attention most sincere. In a corner of the parquet, at the front, the national colors, folded and draped, were placed by the patriots of the Lucius Fairchild post of the Grand Army who came in a body. Deans of the various departments at the university occupied the stage, with the speaker, the university glee club, and Dr. C. R. Van Hise who presided, and boys of the law school, many score, state officials, members of the supreme and other courts, of the university faculty and of the Madison public in general composed the hundreds who testified their affection for the distinguished dean by their presence. The exercises were under the auspices of the university faculty, and were arranged by a committee comprised of Professors R. M. Bashford, W. A. Henry and Storm Bull. The glee club sang sweetly both before and after the address. Senator Vilas spoke, it was evident, from the depth of a heart deeply touched.

SENATOR VILAS' TRIBUTE.

I address you at the invitation and on behalf of his associates of the faculty, in attempt to portray the life and commemorate the excellence of Edwin Eustace Bryant, late dean of the college of law in the University of Wisconsin. We would testify respect and affection for this good man lost to us; regardful of his faithful labors in education of men, of his learning, his lofty aims, his inspirational power, his noble attributes of character; with love that entwines his cherished memory like a blossoming vine, rooted in his rich amiability and redolent with the sweetness of his soul.

The tribute will be prosperous accordingly as the portrait of the man shall be true, his doings fairly told. For he needs, as we think, no ascription of virtues not undeniably his own, no adjectives of mere eulogy; no borrowed plumage or perfumed speech. He shall be lauded for no majestic greatness of intellect, no masterful stature among his fellows. But in what he truly was, noble in spirit, zealous in labor, eager for usefulness to others, gentle and sweet in intercourse, self-sacrificing and tender, seeking always that men might be better and happier for him;

there will be found the attributes, in riches, which must worthily keep his memory green.

What matters it that in not all things he had the power some other might possess; that in not all undertakings he climbed the possible heights? Be sure his ideals fell not below the justest aims; be sure if any rose higher it drew not envy but encouraging cheer from this honest heart whose delight was in good things well done for men.

Our purpose is no obscuration by clouds of praise, but to limn in just and clear perspective, the true image of the good soul which, casting its earthly cerements, has obeyed the master's call. Yet my foot trembles on the threshold of trial and desire. For he was my intimate friend, and for more than thirty years we footed the path of life in close companionship. I loved him; I know he loved me.

Beyond the holy circle of family and fraternal tenderness, none other ever so familiarly permeated all the byways of my aspirations, purposes, thoughts, and work; none other was so in and out of me, joyously welcome at every hour, none so cheering, soothing, helpful, faithful, so honestly to rejoice in things approved in the doing; alas! not so to palliate shortcoming in ends or deeds. What would have been, must be, life with no such friend! What a boon from heaven, at one's right hand to have such true and trusty sympathy, tender as woman's, yet sturdily strong in intellect and righteous in character to sustain and share, with unbending spirit, the projects, studies, aspirations, yea, indignations, which the problems of life force upon every stirring mind! How lighter lie the burdens of care, of deep-moving meditations, when there is a yoke-fellow in trusty intercourse, to share, with responsive counsel! Earth can proffer, beyond the bounds of domestic bliss, no better joy! If by and bye such ties are renewable, the mortal stroke knocks indeed, at the door of happiness and heaven.

BOYHOOD.

Bryant was born among the rocky ridges of the Green mountain state, at Milton in Chittenden county.

DEAN OF THE LAW SCHOOL.

Early in 1889 President Chamberlin was seeking a dean for the college of law. Applying to me to take the post, I pointed to Bryant as a prize. Senator Spooner, who intimately knew his fitness, cordially joined in effective commendation; and when the General came home on the first of May, the crowning work of his life stood assigned to him. His labor of preparation began at once; his instructional service with the opening of the university in the autumn of 1889. Fourteen years of unbroken continuity followed; how ardent, severe and self-sacrificing few beyond his household circle entirely realized. I sometimes admonished him that his application was excessive, but with small effect. His devotion was not simply conscientious; he burned with appreciation of the high duty his position demanded for usefulness to the university and to the profession. He saw its possible value to others far beyond a gratification of personal ambition, to be worthy in it, indeed, was all his ambition, deeply feeling it to offer his last and noblest life performance. And he felt the due measure, and chiefest means, to success in it, was assiduous, untiring industry, to work with all his might to make avail of the utmost limit of his talents. He never paused to inquire what might be demanded of him, what would be taken as satisfactory by the governing authorities. The simple question was, How can I do more to promote the good end?

HE WAS TIRELESS AND UNSELFISH.

This fervor of spirit was well illustrated in his assumption of a class at the capitol. It happened that there were many ambitious youths in the state's clerical service who desired instruction in the law but were denied by their employment attendance by day upon the lectures of the college of law. One of them, W. F. Dockery, now resident in St. Louis, may tell the story:

"In the fall of 1891 some fifteen of the employes about the state capitol, I being one, resolved to read law. Our duties made it impossible to attend lectures on the hill. Plans to secure the services of various lawyers and judges in the city to direct us in our work were suggested. After investigating, our committee reported the outlook for getting us on a working basis as dis-

couraging. Finally, the committee waited on Dean Bryant for suggestions on ways and means, not for a moment expecting his services. Without a moment's hesitation or apparent thought of the additional labors he was assuming, he said, 'Go back and tell the boys I will see them through myself.' We were jubilant; the way to the honors and emoluments of the legal profession seemed cleared of all obstacles. Daily for two years he met us at the capitol, and helped us over the hard places of the law. Often he was well nigh exhausted with the burden of the day, but there was always that genial smile and that kindly light in the eye which, with the youngster, never fails to put discouragement to flight. As for remuneration, he would have none of it. 'The pleasure it gives me to be able to help you up the first few rounds of a great profession is worth more than gold and silver to me,' was his reply." And Mr. Dockery with other comment, well add: 'Not the least of the benefits we got out of our law course was the opportunity of knowing so sunny and lovable a personality.'

The story is characteristic. Appeal to his generous enthusiasm was never vain. The auxiliary service so inaugurated he continued long. It severely wore upon nervous energy. He pursued it with doubtful wisdom, sacrificing hours demanded by nature for vital reparation; and was compelled at last to yield. But that was Bryant—striving to exhaustion.

WONDROUS IN SYMPATHY.

His sympathy with young men was exquisitely keen and tender. He warmed with admiration and pride to all whose aptitude and progress gave promise; to those of good parts but slow comprehension he was patient, inventive of suggestion, fertile in illustration, inspiring, and to them naturally weakest yet sincerely ambitious of learning, he was considerate and untiring in his efforts to aid.

Another writes: "I was working my way through the law school, had a position down town paying a small amount monthly. At the beginning of the second year I had saved but half of fifty dollars tuition. I asked the dean to accept half and wait for the balance. He said the matter was beyond his jurisdiction. 'But,' he said, 'come to my house in the evening and I will give you my check for fifty dollars and you can let me have it back

when able.' I had been a little nervous during the interview, and when the dear old man laid bare his affection for me in that generous way, the quick tears sprang and the rest of the interview was hurried and short. I thanked him as best I could and got out. I made other arrangements to pay the tuition and might have thought the offer lightly made had not I met the General in the hallway two days later, when he drew me to a corner, put his arm across my shoulders, and said, 'You haven't been up to get that check.' I explained and he assured me that I must always feel that when in difficulties I could go to him, he was always ready to help 'his boys.'"

That was, indeed, but simple truth. His benefactions were many; nor ever, I think, did deserving students lack his aid. These contributions sometimes "fell on stony ground," but mistakes did not impair the flow of his sympathy or help.

GIVES UP VACATION.

Another form of its manifestation was the surrender of vacation rest in aid of some behind in work, or who, from necessity, sought graduation in less than the prescribed time.

An instance from one such: "During the summer vacation of 1890, I, with fourteen other law students, put in three months with Dean Bryant at his residence, receiving private instruction, so that we might pass the examination for advancement to the senior class the following year. Of course we all expected to pay for his time and trouble, but he absolutely refused any compensation, saying: 'I was a poor boy once and know how hard it is to get started in life.' So we all chipped in and bought him a revolving bookcase, which, by the way, he was badly in need of, and arranged to have it delivered during our last recitation at his house. It was brought in and presented by one of the boys and I shall never forget the scene. Tears trickled down General Bryant's cheeks and he was so overcome by emotion that he was unable to respond without considerable effort. I am sure Dean Bryant prized this small token from the boys more than he would a money consideration for his services."

NEVER AN UNJUST PENNY.

In all the intercourse of his years with fellow men outside it,

if he left one enmity to upraid his memory, it was in a scoundrel's heart. For so upright and unexacting was he in all his dealings that, whatsoever he received of possessions, of happiness, of good fame and honor, came always short of his true deserving. I dare affirm with no shade of doubt that never in all his days did he acquire an unjust penny, do an unworthy deed, receive award of merit not entirely his due. If, in any error of judgment, any slip of haste, he mistakenly dropped a word of harm, quick atonement followed its discovery.

I have recounted as his shining achievement of what men call greatness: no lustrous triumph in advocacy at the bar; no supremacy in the state, no preeminence in arms, no wondrous writing. But it may be truly said, if all men were as he, the greatness of any would be little needed. Among such a people peace and kindness would discard necessity of warriors, statesmen, courts, officials, requisite now to master passion, fraud and wrong. Yet though his ambition aimed at lower flights, it led him where his usefulness to fellow men attained to the best performances his gifts from nature enabled. Could he render better account for the talent given by the master? A sweeter soul of human kindness, gentleness, devotion and good will, a spirit of higher rectitude and purity, the angel of death has rarely ushered to the realms above. If amidst the greedy strifes of earth, it may not be here a treasure of enduring memory, let us rejoice in the faith which assures him an eternity of recognition in heaven.

DANGER IN SHIPPING CANS.

(Notes of experiments made at the Cold Spring Harbor Hatchery of the New York Forest and Game Commission.)

BY M. C. MARSH, U. S. BUREAU OF FISHERIES.

Fish culturists and hatchery men generally may be interested in the following brief summary of experiments made at the Cold Spring Harbor station of the New York State Commission, with galvanized iron and brook trout. I do not know that fish culturists have regarded this material as perfectly harmless but I believe it is more injurious than is generally supposed. I began with McDonald hatching jars using only two fry to the jar, and spring water at about 61 degrees F., keeping the water cool by standing the jars in cold running water. There was no change of water within the jar during the experiment. In the first trial 288 square inches of galvanized iron strips were placed in the jar and the fry were killed within fifteen hours. In the second trial 144 square inches killed them within twelve hours. In the latter case the area of galvanized iron exposed to the water was much less than would be the case were the jar made of or lined with this material. Under the same conditions but without the galvanized iron two fry will live for days in one of these jars.

I next tried galvanized iron transportation cans. In general the result is about the same. Fry are killed within within nine to twelve hours in such cans when the inside surface is unpainted or unprotected in any way, and the water stands. It did not make much difference how much water the can contained. In these cases only a few fry were used so that the water did not require artificial aeration during the experiment. A similar can coated with tar inside, but with the other conditions the same would hold the fry without loss, for the given time. The cans used, save in one case, were new, but had been thoroughly washed with water. In the one old can the fry lived somewhat longer, two of four fry dying within twelve hours and two within twenty-one hours.

One trial was made with 300 fry in a can with three gallons

of water, which was aerated with a dipper every quarter of an hour. The temperature of the water was kept between 57 degrees F. and 59 degrees F. After five hours twenty-one fry had succumbed, the others were showing distress, and the experiment was abandoned in order to save the fry. A can painted on the inside was carried as a control during this experiment, under exactly the same conditions and of its 300 fry only two were dead at the end of five hours.

I think one may confidently say that galvanized iron is dangerous for brook trout fry and that therefore galvanized iron containers unless coated in some way, are to be avoided if the fry are to be held long in them. Of course if there is a flow of water the poisonous agent will not become concentrated enough to do harm, but if the water stands in contact with the metal something goes in solution and becomes strong enough after several hours, more or less, to kill brook trout fry and perhaps other species. I suppose that it is the zinc of the galvanizing process which comes off. Various conditions probably may modify the toxicity, as for instance different waters would probably dissolve the metal differently, and different galvanizing processes may perhaps give different results.

I imagine that fish culturists in transporting have lost fry and possibly larger fish from this cause, perhaps without discovering the real trouble. Often on short trips no trouble may come and no doubt the conditions sometimes permit without harm a longer exposure than proved fatal in the few observations I have made. Moreover fry may gradually become accustomed to water containing zinc. Some of the above experiments were recently repeated at the St. Louis Exposition and the results showed a much less injurious effect for the galvanized iron. But the fry used were taken from the water in which zinc had been slowly accumulating, and analysis showed it had taken up appreciable quantities of the zinc.

FISH AND GAME DEPARTMENT OF THE UNIVERSAL EXPOSITION AT ST. LOUIS

BY TARLETON H. BEAN.

The indoor exhibits of the Department of Fish and Game are combined under the same roof with those of the Forestry Department because of the intimate relationship between the forests and the waters. This building, known as the Forestry, Fish and Game Palace, is 300 feet wide and 600 feet long, containing about four acres of gross space. It is well filled with exhibits coming within the classification of the Forestry and Fish and Game Departments in nearly equal portions. As the amount of space applied for in these two departments, however, up to the middle of July, 1904, is 353,451 square feet, and the net exhibit space in the Palace is scarcely more than 105,000 square feet, it would be surmised that the displays now installed represent careful selection.

This eagerness to participate in the competition for awards at the World's Fair at St. Louis was characteristic in all the departments. It has probably never been surpassed at any other Universal Exposition.

In the Fish and Game Department there are exhibits from twenty-four foreign countries in the competitive class, besides those coming from Alaska, the Philippines, the United States Bureau of Fisheries, and the United States Zoological Park. The following countries are included in this category: Argentine, Austria, Belgium, Brazil, Canada, Ceylon, China, Cuba, Costa Rica, Egypt, France, Germany, German E. Africa, Great Britain, Guatemala, Hayti, Honduras, Japan, Mexico, New Zealand, Nicaragua, Peru, Portugal, Porto Rico, Siam and Venezuela. The following states have contributed to this department: Arkansas, California, Colorado, Connecticut, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Montana, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Virginia and Washington.

Minnesota, Missouri, New Jersey and Pennsylvania have

displays of living animals; with the exception of Missouri these exhibits are confined to fishes and other aquatic forms. Missouri has a tract of more than two acres west of the Forestry building on which is located an artificial lake, 200 feet long and 50 feet wide, around which are installed enclosures for deer, black bear, beaver, wild cat, puma, coyote, grey wolf, red fox and grey fox. In connection with this outdoor space a small hunting lodge has been established in which are to be found a library of literature relating to hunting and fishing, game trophies, hunting and fishing implements, and other reminders of outdoor sports.

Canada has six live beaver in a pool. These animals have made themselves entirely at home from the first and have been an unfailling source of attraction to visitors. Oregon has brought some living Mongolian pheasants of the species successfully introduced into that state some years ago. Colorado has a three months old black bear cub which at present is kept outdoors in the reservation for Missouri. New Jersey occupies the great swampy pool in the center of the building for large game and food fishes of the Atlantic coast. The complete stocking of the aquaria has been deferred on account of the delay in supplying cold water for trout, salmon, pikeperch, small mouth bass and other species which will not live in water of the ordinary summer temperature of this region. Washington has hatched eggs of the steel-head trout and now has a supply of these eggs in storage awaiting the introduction of the cold water system.

The wild game of the world is well represented also by taxidermy, skins, furs, animal products and illustrations. A single exhibit of furs, mounted and unmounted rugs, skins, game trophies, animal traps, etc., occupies a space 80 feet long and 20 feet deep. In the exhibit of New Zealand is a fine collection of the heads of red deer and fallow deer, besides the mounted skins of the brown trout of Europe and the rainbow trout of California, all of which animals have been successfully introduced in New Zealand within the last thirty years. Among the finest of the illustrations are the flashlight pictures of wild deer taken at night in the wilds of Michigan by Hon. George Shiras, 3rd., of Pittsburg, the animal paintings of Alexander Pope of Boston, the taxidermy of H. L. Rand of Worcester, the butterfly mounts of C. B. Riker of New York, the splendid series of Indian im-

plements shown by Mr. Miller of Elgin, Ill. The game trophies exhibited by Canada, Great Britain, Germany, Ceylon, Egypt, Venezuela, German East Africa, South Africa, Guatemala and Mexico are especially noteworthy, while the states of Oregon, California, Washington, Wisconsin, Pennsylvania, New York, Minnesota, North Carolina, Louisiana, Mississippi, Rhode Island, New Jersey, Colorado, Montana and Virginia contribute materially to the pleasure and information of visitors.

New Zealand demonstrates effectively what can be done by intelligent effort on the part of acclimatization societies and governments when they undertake to increase the fauna of the country suitable for certain forms of animal life. The introduced fish as well as the deer and other mammals have prospered beyond all expectation.

In the hunting equipment the department is unusually strong. The development of the modern breech-loading gun from the primitive bow-gun through all the various steps of the wheellock, matchlock, hammer gun and hammerless, is well shown by the United States Cartridge Company in one of the best collections of arms to be found in the United States. The Winchester Repeating Arms Company has established a shot-proof house west of the Forestry building at which to test the accuracy of the Winchester rifles. This is open to the public for inspection although no shooting is done except by experts employed by the exhibitor. Demonstrations are given twice daily, one in the forenoon and one in the afternoon.

Foreign countries have also played an important part in this group of exhibits. The gun exhibits of Belgium, France, Germany, Egypt, Great Britain and other foreign countries are remarkably full and satisfactory. Great Britain, for example, has displays from ten of the leading gunmakers of the United Kingdom, while Belgium and France have fully as many or more contributing firms, and Egypt has sent a collection of her native weapons of warfare and the chase. The South African collection is not now a part of the competitive exhibit but is displayed in the Anglo-Boer war concession in a separate museum.

Fishing tackle and other appliances for angling and commercial fishery are very well represented by exhibits from several foreign countries as well as from the best known manufacturers

of the United States. Japan, as usual, has a very complete exhibit in this group. The fishery products have not been placed in the Palace of Forestry and Fish and Game unless accompanied by models showing the methods of preparation. One of the most instructive live exhibits of this kind is the illustration of the Alaskan salmon country and of the methods of preparing salmon shown by the Alaska Packers' Association of San Francisco. This includes a waterfall and series of cascades and pools with mountain and lake in the background and a painted representation of a cannery building, boats and vessels, together with log cabins, a miniature cannery reproducing every detail of the work and samples of the preserved salmon, together with salads which are distributed to visitors at certain times during the day.

The apparatus of modern fish culture is shown by Japan, Pennsylvania and Washington. Great Britain has a splendid collection of the results of deep sea investigation from the Marine Biological Laboratory of Liverpool.

Pennsylvania's display includes a little waterfall running through a cement canal into a great pool which contains big fish. It has also 35 aquaria for food and game fishes of the state. Missouri's tanks are arranged in a sort of grotto. Minnesota also has a grotto with fifteen large tanks arranged on the two sides of a fifteen-foot aisle.

The Forestry and Fish and Game Palace is characterized by its central nave and its ends which are 85 feet wide. This feature gives opportunity for convenient arrangement of exhibits and has been fully utilized in the work of installation. The lighting and ventilation are excellent and the presence and sound of falling water add a charm which is not easily forgotten. The standard of installation is very high, excelling anything of the kind within the writer's exposition experience. The popularity of the palace is well attested by the fact that it is always crowded when the attendance in the grounds is large. This is shown by the record of July 4, 1904, when the register of the California exhibit received 1,540 names of visitors. The wide aisles of the building were completely filled so that it was almost impossible to stem the passing throng. Representatives of many foreign countries have expressed their approval of the character and installation of the exhibits and the general opinion freely

expressed proves that the association of exhibits related to the forests and the waters is attractive to the public and furnishes ample opportunities for recreation and study.

It is unfortunate that the component parts of such exhibits should, for any reason, be widely scattered over the enormous area occupied by exhibit structures. It would have been far better if all the exhibits coming within the classification of the Fish and Game Department had been assembled together; the opportunity for comparison and study would have been greatly enlarged. It would indeed be far better if the various departments of the United States government should join with their fellow countrymen and with the people of foreign countries in friendly competition; in no other way can the lesson of superiority be grasped at a glance, and in no other way will the progress of nations be best promoted.

The Universal Exposition at St. Louis is in the judgment of persons best prepared to decide, the finest exhibition of the present condition of the world's progress that has ever been seen. What is true of the Forestry and Fish and Game Departments is equally true of all other departments of this exposition—the materials exhibited and the standard of installation are higher than at any Universal Exposition which has gone before. This is the deliberate opinion of exposition experts of all countries, and it will be confirmed by the unanimous verdict of intelligent visitors.

NOTES ON STURGEON CULTURE IN VERMONT.

E. N. CARTER.

The spawning season of the sturgeon in the Missisquoi, Lamoille and Winooski rivers—all Vermont tributaries to Lake Champlain—is from the first of May to the middle of June, at least the main run of these fish appear in the above mentioned rivers between these dates. In his report for 1901, Mr. Livingston Stone, referring to the sturgeon of this lake, says: "They are doubtless spawning somewhere all summer," and this is also the opinion of many of the Champlain fishermen, who have stated to me that late in the fall they have caught female sturgeon from which the eggs flowed as freely as they do in mid-summer and earlier. So far as the propagation of this fish is concerned, however, I think that the above dates may be considered as marking the time limits of their spawning period.

Their first appearance in the rivers is so sudden, and their stay on the spawning beds so short—three or four days, only, being apparently sufficient for the deposit of their eggs—that every preparation to handle them must be made in due season.

The past spring it was decided that this work—after a lapse of three years—should again be prosecuted in Vermont by the United States Bureau of Fisheries. Upon the completion of the pike perch operations, therefore, arrangements were immediately begun for the collection of sturgeon eggs in both the Missisquoi and Lamoille rivers, and parties owning the necessary equipment were employed to do the fishing. Nets were operated in the Missisquoi and at various points in the bay of the same name, night and day from May 5th to 27th; but during this period only three sturgeon were captured, while in the same river and using this method of fishing Mr. Stone three years before had secured upward of thirty fish. The three taken this year—a large female which had already spawned, or which was very green, and two males—were liberated after being held for ten days.

At the mouth of the Lamoille river a number of nets were set on May 7th, and fishing was regularly continued in various

localities in the river and in Malletts bay until the 26th, during which time four males and two females were secured. These were held in crates until the 29th, upon which day the entire lot was liberated, the females showing no nearer approach to spawning than when captured. A heavy rainfall on May 24th caused a rapid rise in the river, and on the following day the nets were parted in midstream by the force of the current. It was thought that this high water would bring a run of fish into the river, and, as it was impossible to intercept them by means of the nets, work was discontinued at this point and the necessary equipment, etc., was transferred four miles up the river to what is known as "Sturgeon Hole," at West Milton, where Mr. Stone had taken these fish in large quantities three years before. Here a man experienced in the "hooking up" method of capturing sturgeon was employed. Sturgeon Hole is a natural channel, or break, in the rocks forming the bed of the river just at the foot of the falls, above the village of West Milton. The spawning fish lie in this hole, which is forty feet deep, and it is impossible to take them by any other method than this "hooking up," as it is locally termed. The equipment used consists of a heavy hand line, a two-pound sinker, six or eight extra large fish hooks, and a strong pole eight feet long and about two and a half inches in diameter at the butt. The hooks are fastened together back to back, anchor-shape, and then attached to the line at distances of eight inches, the lowest pair being about this same distance from the sinker.

The boat in which the fisherman stands having been anchored to the rocks at a suitable point, the weighted line is cast into the swift water at the upper end of the hole, and as soon as it touches the bottom the hooking-up is begun. This is nothing more than a succession of yanks, continued while the sinker is being carried by the current along the length of the channel some seventy-five feet, with the object of forcing one of the hooks into a sturgeon's body. This method sounds extremely barbarous, and it was anticipated that the fish would be badly torn. As a matter of fact, however, of the fifteen sturgeon so taken, thirteen were hooked in the under side of the caudal peduncle, and the others in the thick portion of some one of the fins. Owing to the great toughness of the sturgeon's skin, the wounds inflicted seemed of

little consequence, and the fish were none the worse, so far as could be seen, when they were liberated from the pens three to six days later.

Of the sturgeons captured in this manner, ten were males averaging about thirty-five pounds, and the other five were females of 85, 100, 125, 140 and 150 pounds—estimated weights.

As it was known that the eggs are thrown by the ripe female sturgeon as soon as she is lifted from the water, a suitable plug was designed and fastened to the fish as soon as captured. This gave very good satisfaction. It consisted of an ordinary rubber nipple; a piece of heavy belting leather six inches long, four and a half inches wide at the broad end and tapering to two inches with rounded corners; and a piece of elastic suspender-webbing two inches wide and of suitable length. The large end of the nipple is sewed, in an upright position, in the center of the widest part of the piece of leather and forms the plug. Two slits, a quarter of an inch apart are cut on each side of the nipple, and under the strips of leather thus formed is drawn the webbing which is passed around the body of the fish to hold the plug in position, an ordinary adjustable suspender buckle being used in connection with this girdle. The smaller end of the leather back is held well forward by means of a soft laid linen thread, which is tied around the sturgeon's body just ahead of the ventral fins. This is to prevent the plug from slipping back toward the tail, which it would otherwise do owing to the tapering of the body.

It was our good fortune this year not to secure a female that was ripe at the time of capture, but had we done this it would have been necessary to plug the vent temporarily with a piece of cloth, as the rubber plug could only be inserted to advantage when the fish is in a straight jacket.

In the morning of May 29th it was discovered that one of the large females had rubbed off the plug, and had ejected the larger portion of her eggs. (Note: Tape instead of linen thread used, etc.). She was immediately placed in a straight jacket and the balance of her eggs secured. These were milted and allowed to stand in the bucket, in the milt, for 30 minutes, when they were washed up and a stream of running water from a nearby brook flowed over them. In the afternoon of the same day

it was found that these eggs were covered with very fine sand, and they were therefore placed in floating boxes anchored in the river. From the five females on hand 1,500,000 eggs were secured, and the entire lot was held in the floating boxes.

During the first 24 hours they all presented a fine appearance, and, although in bunches of varying sizes, it seemed that a fair percentage of them might be hatched. This hope was dispelled on the following morning when it was known that fungus had already attacked the entire lot. It was practically impossible to do anything to save them, as they were like so many bunches of half dried glue. By June 3rd every egg was dead, and they were all dumped into the river.

After handling these sturgeon eggs, it is almost incredible to me that they can be permanently separated and made to work in jars, like pike perch and whitefish eggs, as was done by Mr. Stone in his work with the sturgeon several years ago. A number of the ordinary Macdonald jars were on hand for use in this way, but owing to the poor quality and insufficient quantity of the only available water supply they were not brought into service. The eggs from one of the large sturgeon were stripped into a wooden pail, and, after being thoroughly milted, were stirred with the hand continuously for forty minutes. As long as the eggs were agitated in this manner they remained separate, but when water was added and they were "washed up" the expected adhesion took place, and when allowed to sink to the bottom of the bucket they immediately formed into a mass. This mass could, of course, be broken up into small bunches, but many eggs were ruptured in the process. It may be possible that could the eggs have been placed directly in the jars in the milt, their separation might have been accomplished. This is one of the methods that it is hoped can be tried another year.

When stripping the above lot of eggs, it was noticed that when they flowed over the sides of the bucket they adhered most tenaciously, and in a single compact layer. It was later found impossible to remove these with a strong stream of water from an ordinary garden hose. I therefore believe that as the eggs flow from the fish they can be made to pass over thin boards, then milted, and afterwards held in some wire mesh receptacle in a swift current of water.

DISCUSSION.

Mr. Carter: Before reading what I have here I should like to say that it is not in any sense a paper on Sturgeon Culture, in the ordinary sense of the word, but rather a few notes on some work I have been doing in Vermont during the past spring.

During the reading of his paper Mr. Carter said:

I have here two pictures of a ninety-pound sturgeon containing eggs, which I will hand around, just to show the size of the fish we handle.

Mr. Titcomb: Is that a ripe sturgeon?

Mr. Carter: No. We concluded after she was opened that she was within three or four days of being ripe.

Later on during the reading of the paper Mr. Carter said: We found that a linen thread held the plug in position better than any other material that we had.

(Near the end of the paper.)

The floating boxes were fry carrying baskets, having thin board sides and perforated bottoms and ends, and we anchored these in the river.

(At the end of the paper): We allowed about 50,000 eggs to the quart.

President: This paper is now open for discussion. Those that have been interested in trying to collect sturgeon's eggs will doubtless have something to say on this matter.

Mr. Meehan: Pennsylvania has met with no success whatever in trying to hatch sturgeon eggs. One trouble we found was in securing the two sexes. There has been an alarming decrease in the number of sturgeon in our waters, and for two years our superintendents have endeavored to get males and females in order that we might undertake the work of propagation. Last spring they succeeded in getting several females but did not get a single male. Sturgeon culture is a question that is interesting the department of fisheries in Pennsylvania exceeding-





ly, and if anyone has had any other experience we would like to hear it, and also would like to hear from Mr. Stone, who has had considerable to do along this line.

Mr. Carter: I do not mean to infer by what I read that I doubted Mr. Stone's statement that he separated his eggs. I know that he did succeed in separating them in jars at Swanton and West Milton also, but it was impossible for me to do so.

Mr. Titcomb: I would like to have Mr. Stone explain how he did it. He is our expert on sturgeon, I believe.

Mr. Stone: The few sturgeon eggs that we took and succeeded in hatching we treated the same way as we usually treat pike-perch eggs, by using mud, sand, muck, or something of that kind; we did not have any difficulty in separating them when we treated them in the way we did pike-perch eggs. In fact we had no trouble with them whatever. We put them in jars and they hatched out all right.

I do not think there need be any trouble about hatching sturgeon eggs if you can get them impregnated. The trouble is to find a female and male at the same time so that you can have milt to impregnate the eggs with. I have hunted sturgeon for many years in Lake Ontario, Lake Champlain, Missisquoi river and Lamoille river the Delaware river and Delaware Bay, and the only place that I know of anywhere in the country where you can get sturgeon eggs and impregnate them, is in the "Sturgeon Hole" of the Lamoille river, that Mr. Carter mentions.

The sturgeon come up there at a certain time in large numbers and continue spawning there for twenty-four to forty-eight hours; and if you can get them right there in the sturgeon hole while they are spawning you can get males and females that are both ripe, and if you can do that you can impregnate the eggs and hatch them.

Mr. Titcomb: Do you mean they come every year the same day?

Mr. Stone: Pretty nearly. It depends upon the temperature of the water—it must be at least 66 degrees. When the temperature of the water rises to 66 degrees the sturgeon will

come up, collect in great quantities there and spawn, and both sexes can be caught ripe at the same time.

Mr. Meehan: I would like to ask Mr. Stone whether he has ever found ripe eggs and held those eggs in an attempt to fertilize them later, keeping them for example all the way from one to forty-eight days.

Mr. Stone: No, all were impregnated at once.

Mr. Carter: The substance stuck to the eggs so that I could not wash them up. They formed a sticky mass like little pieces of half dried glue. They stuck to the sides of the bucket, and to anything at all that was put in there, and it was impossible to break them apart without rupturing a great many eggs.

As to the time to look for the sturgeon, you may expect them there from the 25th of May, on—they have been found ripe until the middle of June, I understand, in the sturgeon hole. At the mouth of the river they look for the blossoming of the shad-trees to determine the date of ripeness of the fish; and some farmers think when the apple-trees are in blossom the fish should be ripe. We also looked for a water temperature, of from 66 degrees to 69 degrees, but none of those conditions seemed to bring along the ripe fish. I later found them in the sturgeon hole when they came up during the high water.

Since taking up this work I have succeeded in securing some pamphlets from Washington relating the experiences of some German fish culturists in handling sturgeon eggs, and they had the same experience that I did, viz., that of having the eggs stick badly to almost anything they came in contact with, but I believe they have been successful in a number of instances.

Mr. Jones: I would like to inquire what the method of measuring sturgeon eggs was and whether or not there was any variation between the eggs taken from different sized fish.

Mr. Stone: We used to count the number of the eggs in a fluid ounce in the ordinary way. Mr. Carter says he counted 50,000 to the quart.

The eggs used to vary very much indeed. Sometimes we would get eggs that were twice as large as others that were taken and sometimes they often varied very considerably.

Mr. Worth: Were the eggs all one color, or were there any markings on them?

Mr. Stone: They seemed to be all alike, but they are very much marked you know. They have very curious markings.

Mr. Worth: I never had the pleasure of seeing but one lot, and there were so few left in the fish that I don't know whether they were in normal condition or not; but it strikes me that they were of a dull grayish color in general and that there was a dark central spot—black. That was on the Delaware River.

Mr. Stone: That is about it.

Mr. Carter: The eggs we had varied from a dark alive to a light brown, and were comparatively small when they came from the fish—I mean that they were probably an eighth of an inch in diameter, but after being in water for a while they seemed to swell. It is was not exactly a swelling process either, but this gelatinous-like substance seemed to form about the eggs, and the thickness of the substance was about equal to the diameter of the egg; so the egg was about three times as large after this process took place in the water as it was when it came from the fish. I do not know that there is any "gray" about it—this gelatinous substance is transparent and very sticky. As stated in my paper, they stuck to the side of the bucket and to boards so tenaciously that when we held them under the hose, with which we siphoned the water out of a pond above, thus obtaining a 15 foot fall, we could not force them off the side of the bucket. I presume in nature they stick to rocks, logs, etc., in the same way.

President: Having had a little experience in this matter years ago, it might perhaps be well to bring it up, although I think it is published in some of our earlier reports. One of our superintendents now in South America, was foreman at our Alpena station from 1883 to 1887; and some experiments with sturgeon were made on Detroit River during that time. We did not succeed in catching any sturgeon that were full of eggs. We got some that had partially spawned out, and we got a few of the eggs. There was no difficulty whatever, as Mr. Stone

says, in impregnating those eggs and in getting a good impregnation. I think our record will show a hatch of something like 90 per cent. I think Mr. Carter is mistaken in his estimate of 50,000 eggs to the quart; and his own later remarks would lead one to that conclusion; for eggs one-eighth of an inch in diameter will not go 50,000 to the quart. It is true that that is about the size of them, and they enlarge slightly I think. (Mr. Carter said three times.) That was not my experience. We found that where they originally ran eight to the inch after they had become enlarged and water-hardened they would run about six to the inch. Their color after they are impregnated and water-hardened and have come up in shape, is that of white-fish eggs, such as we can get up in the northern waters of the Great Lakes—a little on the yellow order, but clear and transparent; of course as the fish develop in the eggs you can see them moving right along the same as in the shad and white-fish. They are as easy to hatch as the grayling egg or white-fish egg.

Mr. Carter: Did you put those eggs in the jars as soon as they were impregnated?

President: We did not hatch them in jars.

Q. How did you prevent the sticking?

A. There was no trouble about their adhering at all—any more than there is in pike-perch eggs. The eggs should be looked after carefully from the time they are taken away until they are impregnated and water-filled.

Q. How long does it take to water-fill them?

A. Do you mean after the eggs are taken?

Q. Yes.

A. I could not tell you, but the eggs were taken on Detroit River, and when they came to us they were brought to the hatchery in from six to ten hours after they were first taken, and were then put on trout trays and hatched. Some of them were hatched in the river in the old fashioned Seth Green floating box.



(See page 64.)



Mr. Carter: One of our lots of eggs was stirred forty minutes and they were thus kept separate, but just as soon as the stirring ceased they would stick.

Mr. Clark: How long afterwards did they stick?

A. Until they were all lost—we could not spread them out at all. I think the time to spread them is when they are first taken.

Mr. Buller: What method do you use in expressing the eggs from the female fish?

President: I cannot tell you.

Mr. Stone: We found we did not have to use any method at all. (Laughter.)

The sturgeon of the Delaware River is an entirely different fish from the sturgeon of the great lakes and Lake Champlain. It is called *acipenser sturio*, while that of the great lakes is called *acipenser rubicundus*. A *sturio* is a sluggish fish, while a *rubicundus* is a very active and powerful fish.

At one time on Cisco River we caught a ripe female weighing 140 pounds, which was a very powerful fish. It took three of us to get her out of the water, and no sooner was she taken out than with one flirt of her tail to the left she disposed of nearly half of her eggs, and with another flirt to the left she threw out the other half. (Laughter.)

Mr Jones: How does Mr. Carter reconcile his estimate of 50,000 eggs to the quart, with his statement as to their size? There must be an error there.

Mr. Carter: Our eggs were counted very hurriedly. I supposed they were counted accurately, but even then we did not get as many eggs from one of these sturgeons as they are commonly supposed to yield. A sturgeon is supposed to yield a million or a million and a half of eggs, but we did not get over half that number.

Mr. Titcomb: What do you mean by the expression, "number of eggs that a sturgeon is supposed to yield?"

Mr. Carter: I referred to the statements given in the Manual of Fish Culture.

Mr. Titcomb: Does that refer to the rubicundus?

Mr. Carter: I suppose it refers to the kind of sturgeon handled by fish culturists.

Mr. Jones: Did you measure those eggs?

Mr. Carter: We measured half a pint and estimated the balance from that measurement as being 50,000 to the quart. We had to do our work very hurriedly and were not prepared to handle the eggs as we thought they should be handled.

Mr. Lydell: I have had a little experience with sturgeon—very limited though. It was my good luck to have the fish commission send me down the Detroit River ten or twelve years ago to experiment with sturgeon. I was very successful in getting a ripe female and ripe male within a few minutes of each other, and they both came ashore at the same time. I immediately plugged the female with my handkerchief, took the milt out of the male, mused it up with a stick like a potato masher, and left it until I got the female ready. And the method I used for getting her eggs was taking a big butcher knife and letting the eggs all fall into a tub, and then I poured the milt in and stirred for $\frac{3}{4}$ of an hour, then the eggs were put in hatching boxes and we hatched something like 185,000, and had no trouble in keeping them from adhering.

Mr. Titcomb: Did you use flat buckets?

Mr. Lydell: No, we used the Seth Green hatching boxes; we put about half a quart in a box and had a row of boxes half a mile long. (Laughter). The little fish I noticed were dropping through the meshes in the boxes, so I got some wire and held some of them until the fish commission got a professor there, but when he got there they were all hatched and in the river.

Mr. Jones: How do you arrive at your conclusion of 185,000 fish hatched?

Mr. Lydell: I did not measure them at all. It is stated that 1,500,000 eggs can be obtained from one sturgeon, and I claim only 185,000, and I do not think when I make such a modest estimate as that, that I should be called on for a count. I think fully 90 per cent hatched. It is so long ago that I do not think I could recall the method we used for measurement, but I know we measured the eggs and counted them. I think it was nine to the inch. The report of this work is contained where in the Michigan Fish Commission report. I would not somewhere in the Michigan Fish Commission report. I would not say as to the 185,000—it may have been 365,000,000. (Laughter.)

President: The records as to Detroit River were not printed in the report of the United States Fish Commission, but there was an accurate record of the size of the eggs and number of eggs we got, kept, and it seems to me now it is something like 50,000.

Mr. Lydell: I thought at that time that the hatching of the sturgeon was the simplest matter I ever ran up against—all I had to have was a butcher knife, two tubs and a couple of sturgeon. (Laughter.)

EXPERIMENTS IN FEEDING FRY.

BY DR. JAMES A. HENSHALL.

In compliance with a suggestion from the secretary of the society I offer a brief paper in continuation of the subject of experimental feeding of grayling and other fry; but as the period has been so short from the hatching of the fry until the preparation of this paper, I have not much additional information to offer.

It is a self evident proposition that by following Nature's methods as closely as possible in fish culture, we will be more successful than by putting into practice mere abstract and theoretical ideas. And this can be accomplished only by closely observing Nature's ways, and preserving as nearly as possible, natural conditions.

In accordance with this principle it is a wise plan to begin the feeding of fry before the yolk-sac is entirely absorbed, for it is reasonable to suppose that fry at that stage are as much inclined to feed as sea-anemones and certain mollusks that are, like Prometheus, firmly bound to a rock, and only obtain their food from the water flowing over them. By this method of feeding, the fry are much stronger when the sac is finally absorbed, and in better condition to take and assimilate artificial food. This applies more particularly to fry that are supplied with water flowing directly from springs, which contains no natural food. This method, I think, is now the common practice, and has been followed for several years. Where stream water is utilized in hatcheries, it contains more or less natural food, and, so far as it goes, is one of the conditions observed in Nature.

At the last meeting of the society I presented a brief paper on feeding alevins with blood, and also on feeding it to free-swimming grayling fry. These experiments were quite successful last year and were continued the present season, and blood, ground with liver in a power chopper, was also more eagerly taken by trout fry than when liver and water emulsion was furnished.

As the fry of all the trout species swim in a horizontal position, and seek their food on the surface, in mid-water and at the bottom of the trough, the common practice of feeding liver emulsion with a feather is more successful than any plan yet proposed. On the other hand grayling fry swim in an inclined position with the head upward, apparently seeking their food at the surface. This is no doubt the case as they do not feed from the bottom of the trough, and this would suggest some other plan of feeding them.

It is well-known to close observers that fry in natural waters are constantly picking at the leaves and fronds of water plants, evidently feeding on small organisms that have found lodgment there. In accordance with this fact, and in imitation of one of Nature's provisions, bunches of water cress, which had been previously dipped in blood or a mixture of blood and liver emulsion, were suspended in the hatching troughs. The experiment was tolerably successful, for it was found that the grayling fry at once resorted to the plants and began picking off the food.

As the troughs were needed for black-spotted trout eggs from the auxiliary station the grayling fry were transferred to nursery ponds, where large bunches of cress and other water plants were suspended and on which the food was deposited. The ponds were supplied with creek water, in which the fry found their natural food, but they continued their attention to the cress to some extent. This plan will be continued until they are old and large enough to be fed the same as trout fry; the food however, will be placed on the plants instead of being thrown on the surface. As blood and liver emulsion does not adhere to the leaves and stems of the plants as long as desired, it is proposed, another season, to mix the food with gelatine of pig's feet or other gelatinous substance to obviate that contingency.

I contemplated using spleen or milt, as I thought it would prove more adhesive than liver, but found it difficult to reduce beef milt fine enough in the chopping mill owing to its fibrous nature. Another season it is proposed to experiment with sheep or hog milt, as I am convinced that it will prove a desirable food for grayling fry in the earliest swimming stage.

Before removing grayling fry from the hatchery, the nursery ponds are prepared for their reception a month or two in ad-

vance, by keeping them filled with creek water with a sluggish current, in order to favor an accumulation of the small organisms natural to the stream.

DISCUSSION.

Mr. Titcomb: That is a very interesting paper, as was Dr. Henshall's previous paper on feeding blood. I do not know whether I gathered fully one point, and therefore raise this inquiry: the principal point, Doctor, in the feeding described in this paper, is not in the class of food but in the method of giving it, is not that true?

Dr. Henshall: Yes, to a certain extent. The paper on blood was complete as far as it went.

Q. You continue the same food?

A. Yes, but now I have a little different method of presenting it.

Mr. Jones: I would like to ask how the cost of blood compares with the cost of beef liver.

Dr. Henshall: I pay nothing for the blood.

Mr. Jones: It is pretty cheap then. (Laughter.)

Dr. Henshall: I have a butcher who understands how to do it. The blood must be stirred very carefully just as soon as it is taken from the animal, until it is reduced to a homogeneous mixture.

Mr. Jones: We pay 3½ cents a pound for beef liver, and if we can get the blood at a less cost we shall be glad to use it.

Dr. Henshall: I pay 3 cents a pound for liver, and I "set em up" to the butcher once in a while for the blood. (Laughter.)

Mr. Cobb: He speaks of the different ways in which the trout and grayling take their food. He says he would use this method of feeding until they will take food the same as trout. How long will this different method be required?

Dr. Henshall: The grayling are very small when hatched—about like whitefish fry or shad fry in size; but after being fed for five or six weeks you can feed them liver emulsion, and after that they will soon outgrow the trout.

Mr. Cobb: I refer to the position of the food. The larger grayling will take their food in any place they find it, will they not?

A. Why, yes, after they get to be about six weeks old; but they are always fed on the surface, and I am trying to devise some plan of mixing liver emulsion with something that will cause it to float longer, but I have not succeeded.

Mr. Seymour Bower: I desire to present for the consideration of the members a model of an automatic fry feeder. It is a very simple thing; in fact its extreme simplicity is one of the main points of recommendation. It is entirely practical, we have tried it, and although we have only used it about a month there is a marked difference in the growth of the fry in the trough where the device is used and in the trough at the side of it.

The device was invented by a man who is really new at the business, having been employed by us only a short time, and having had no previous experience in this work.

(Mr. Bower then described the feeder as follows):

This feeder piece dips down into the food and at every revolution of the overshot wheel the small cup spits out a little liver emulsion from the aperture shown in the device. Of course the amount of food thrown out is regulated by the size of the cup. It is necessary to give this some speed, otherwise it won't throw the food through the aperture. By the use of this device you can put your food in, go away and leave it and it will not choke or clog. It requires almost no extra water to run it. If the trough is twelve or fifteen feet long it will be well to set up a second feeder in the center of the trough. We think it is the best thing of the kind we ever tried.

This apparatus consists of a food-containing box on the inside of which are placed blocks extending the whole length of

the box down to the floor of the box, starting an inch and a half from the top, leaving a flat floor an inch wide and extending the length of the box. This makes the interior of the box which holds the food, V shaped.

The axis extends through the box sidewise three-fourths of an inch from the top and is held in position by a pin at the right hand and a shoulder at the left.

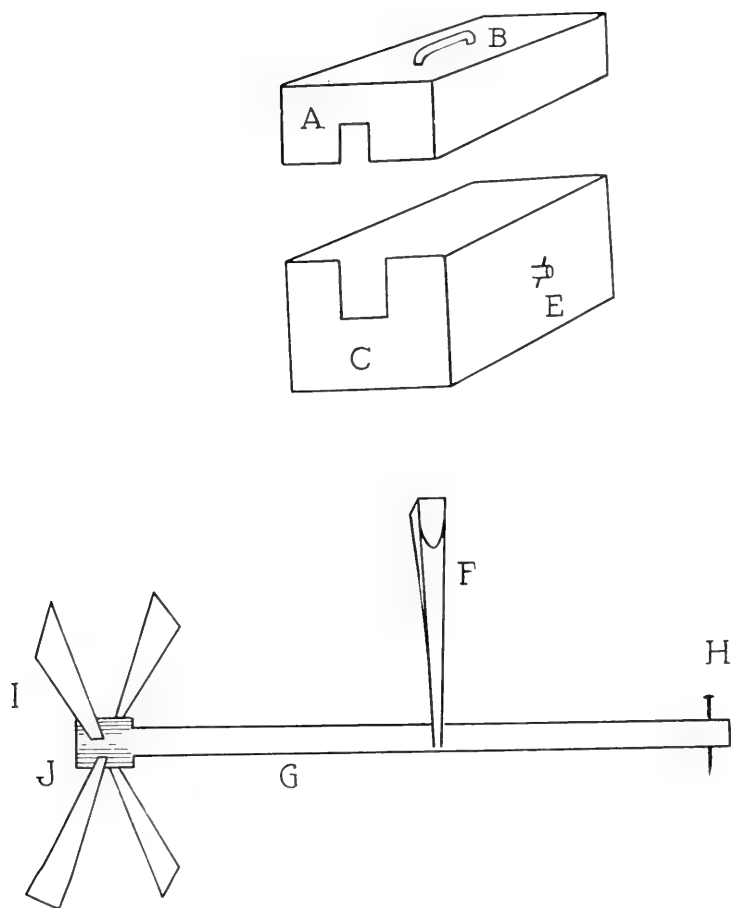
A small scoop spoon is attached to the center of the axis which is caused to revolve by means of a four-bladed water-wheel attached to the shoulder.

The box has a cover.

An opening in front of the box is made both in the cover and in the bottom of the box, through which the food is thrown by the spoon.

A diagram of the box is given on the opposite page.

Mr. Meehan: We have used a similar device to accomplish the same end, for two or three years.



A.—Cover to feeding box.
B.—Handle.
C.—Bottom.
E.—End of axis.
F.—Scoop spoon.

G.—Axis or shaft.
H.—Set pin.
I.—Paddle-wheel.
J.—Shoulder.

A YEAR'S WORK OF THE FISHERIES INTEREST IN PENNSYLVANIA.

BY W. E. MEEHAN, COMMISSIONER OF FISHERIES, PENNSYLVANIA.

Under an act of the legislature of Pennsylvania approved April 2, 1903, the Fish Commission of that commonwealth was abolished and in its place was created a Department of Fisheries. The Act went in to effect on June 1, 1903, and with its beginning may be recorded a new era in fish cultural and fish protective work in Pennsylvania.

In abolishing the Fish Commission and in creating a Department of Fisheries no fault was found with the former. It had done good work in fish culture; but it was felt that the work of fish culture and fish protection had outgrown the system, and that greater effectiveness in both branches would be secured by making the change and placing the work under one responsible head. The old Fish Commission was composed of six members, three of whom have been retained under the new Act. By the change the fish work of Pennsylvania has been given greater importance. The head of the department being in effect a member of the Governor's Cabinet, with a rank equal to that of any other head of Department in the Government of the commonwealth.

By the provisions of the Act creating the Department of Fisheries, there was an official termed the Commissioner of Fisheries, and four citizens, who, together with the Commissioner of Fisheries, constitute an advisory board, known as a Fishery Commission. These four men are in effect members of a cabinet of the Commissioner and its work is as important as that of the Commissioner himself. The Commissioner receives a salary of \$3,000 a year and his reasonable expenses. He is entitled to a clerk and stenographer. The clerk under the act is secretary of the Board of Fishery Commission. The four members of the Board of Fishery Commission receive no salary, but are paid their reasonable expenses. The Board meets quarterly.

The Commissioner of Fisheries, by virtue of his office, is

President and Treasurer of the Board of Fishery Commission. He is also chief Superintendent with full charge of all the state hatcheries. He is also chief Warden, with general charge of that branch of the service.

When the department went into effect there were four hatcheries in Pennsylvania belonging to the commonwealth. Two were owned by Pennsylvania and two were on leased ground. The two former were located at Erie and Corry. The two latter at Allentown and Bristol. The hatchery at Erie was for the propagation of lake fishes, propagated by the jar system. The hatchery at Corry was chiefly for the hatching of brook trout, although experiments had been conducted there in the culture of small-mouth bass and yellow perch. The hatchery at Allentown was for the propagation of brook trout exclusively, and the one at Bristol for the hatching of shad. The shad hatchery at Bristol had not been in operation for about four years, owing to an insufficient appropriation. Under an act of the legislature, known as the General Appropriation Act, \$15,000 was given the new department for the establishment of two new hatcheries, one in Central Pennsylvania and one in Eastern Pennsylvania. Unfortunately no additional appropriation was made for the maintenance of the two new establishments.

One of the first acts of the new department was to get rid of the two leased properties at Allentown and Bristol. The former had long been in an unsatisfactory condition, being in a delapidated state, and generally far beneath the requirements of the work. This was done by making one of the new hatcheries a trout station and establishing it in Bellefonte, Centre County. The other was to locate the river station on the Delaware river at Torresdale in Philadelphia County on ten acres of land, furnished by the City of Philadelphia.

Prominent people in the City of Philadelphia, taking a deep interest in the fish cultural work of the commonwealth, succeeded in interesting councilmen and others to an enthusiastic point on the subject, and in addition to the land furnished, the city councils made an appropriation of \$5,000 with which to assist in putting the new station in working order. A further and heavier appropriation is promised by members connected with the municipality next winter. We thus have the unique

exhibition of a city taking an active part in helping along the fishery interests of a commonwealth. This may be regarded as one of the great pieces of work accomplished by the Department of Fisheries in its first year's work. There are indications that some other cities in Pennsylvania will take a similar substantial interest.

The department is also an advocate of the establishment of a large aquarium for the display, chiefly, of Pennsylvania fishes, and it has again succeeded in interesting the City of Philadelphia in the project. A movement is now on foot for the municipal authorities to appropriate a sum of money for building an aquarium either in Fairmount Park or on the Torresdale hatchery site with the exhibit of the department at the St. Louis exposition as a nucleus.

The Bellefonte hatchery was located early in July and within four months buildings were erected, ponds were constructed, the hatchery in operation, and more than two million and a half of trout turned out before the close of the season. There are twenty-three acres of land in this hatchery. All but three acres of which will be devoted to brook trout work. It is estimated that there is available there eight thousand gallons of spring water per minute, more than twelve hundred of which flow directly out of a spring into the hatching house, and the remainder from a stream which has its origin in two or three springs less than twelve hundred yards away and with a temperature on the hottest day in summer of fifty degrees.

The second hatchery authorized by the legislature was located in Wayne County at a place called Pleasant Mount on the headwaters of the Lackawaxen river. An early winter prevented any work being done until the spring. It is designed to have this hatchery chiefly for the culture of smallmouth black bass, yellowperch, pickerel and for experimental work in rearing Atlantic salmon to maturity for breeding purposes, following the experiments in this particular of the United States Bureau of Fisheries. There is a small hatching house for brook trout, with only fifteen troughs, but with three tiers of nursery ponds of a design contrived by the superintendent of the station, Mr. Nathan R. Buller. By this contrivance it is expected that over a million trout can be turned out from Wayne County, annu-

ally. There are twenty acres of land in the Wayne County tract, two ponds of an acre and a quarter, each are being constructed for smallmouth bass. Two large ponds for yellow-perch have been completed and other ponds are either finished or under construction for other species of fish.

It should be stated that the twenty-three acres of land at Bellefonte and the twenty acres of land in Wayne County were made a free gift to the state for fish cultural purposes by citizens of Centre County and Wayne County with the exception of two acres at Bellefonte and four acres in Wayne County, which were purchased. The three acres of ground at Bellefonte not accounted for is to be used for the propagation of smallmouth bass.

The five hatcheries under the control of the Department of Fisheries are all, with the exception of Wayne, in operation. That is to say, fish have been hatched and distributed therefrom.

Perhaps the most comprehensive method of placing before the Society the work accomplished by the department during the year will be, first, to give it in summary form, as follows:

Department of Fisheries established June 1, 1903.

Began the experiment of rearing whitefish fry in ponds, so that when planted they may take better care of themselves.

Hatched and planted nearly one hundred millions fish in Pennsylvania waters, including whitefish, lake herring, wall-eyed pike, blue pike, yellow perch, blackbass, sunfish, gold fish, brook trout, lake trout and bull-frogs in the shape of tadpoles.

Established Bellefonte hatchery and had it in operation within four months.

Established a hatchery at Pleasant Mount, Wayne County, for blackbass and interior lake game fishes and began the construction of the necessary ponds.

Induced the councils of Philadelphia to turn over to the Department of Fisheries a tract of ten acres at Torresdale on the Delaware river for the propagation of river fishes.

Induced the councils of Philadelphia to appropriate five thousand dollars towards putting the Torresdale hatchery in operation.

Aroused public sentiment to a point, where active steps are being taken to establish an aquarium in Philadelphia.

Aroused public sentiment to the point of taking steps for the establishment of an aquarium at Corry, Pa.

Introduced system of limited apprenticeships in fish cultural work in the state hatcheries and appointed thereto young men from public high schools.

Arranged for the hearty co-operation of the Fish Commissioners of New Jersey to better protect the Delaware river from unlawful fishing.

Took part in successful efforts for a convention of Canada and states bordering on the Great Lakes for more nearly uniform regulations governing the commercial fishing in those waters.

Established the practice of sending out published bulletins whenever there is anything of general interest to those affiliated in advancement of fish culture.

Introduced nursery ponds in the trout hatcheries, the contrivance of one of the superintendents, thereby increasing the capacity of the stations from two to three fold without appreciable expense excepting for breeding fish.

Introduced more economical methods for the transportation of green eggs from the spawning grounds to the hatcheries.

Began the hatching of tadpoles with the idea of encouraging farmers to undertake frog culture, now known to be a coming valuable industry.

Undertook for the first time the culture of lake trout on a large scale, the eggs being gathered from wild fish in Lake Erie.

Undertook the propagation of goldfish for distribution in the public schools for educational purposes.

Brought to a successful conclusion experiments of the Fish Commission in smallmouth black bass culture.

Began experiments in rearing Atlantic salmon in ponds to maturity, from which to breed fry for stocking the Delaware river.

Succeeded in forming a state organization of Fish Protective Clubs and Societies in the various counties, to give wider interest in fish protective work and to give greater assistance to the Department of Fisheries.

Reorganized the fishwarden service and placed it on an effective basis with the results that up to the 20th of July the fishwardens and constables had made 457 arrests; secured 314 con-

victions; and had fines imposed to the amount of \$12,780, of which sum \$9,001 were collected, and those who refused to pay their fines sent to jail for one day for each dollar of fine unpaid.

The Erie hatchery was made nearly self-supporting from the collection of license fees from fishermen on the lake.

Sufficient money was collected from illegal fishermen to operate one hatchery for one year. This is made possible through the department's receiving one-half the fines collected, less five per cent which go to the county treasurer. The other half of the fines go to the wardens making the arrests.

Reorganized the constable service in the capacity of these officers, as ex-officio fishwardens.

Conducted experiments for the extermination of German carp from the waters of the commonwealth as a dangerous and destructive fish.

Built additional ponds at the Corry hatchery for the expansion of its trout work.

Established a Press Bureau by which the work of the department is kept constantly before the public in Pennsylvania with the consequent arousing of strong public sentiment in favor of a great expansion in both fish cultural and fish protective work and which has brought forth a strong demand in all parts of Pennsylvania for the legislature to build and maintain hatcheries for the cultivation of black bass and other suitable fishes which will produce at least an equal number of each species as the state now produces of brook trout, namely, six millions or more.

All of the work accomplished by the department has been on less than \$23,000. Of this sum \$12,500 was from an appropriation for fish cultural purposes and expenses of running the department, three thousand dollars from license fees from commercial fishermen and fishbaskets and two thousand dollars from fines and five thousand dollars from an appropriation to pay the salaries and expenses of wardens. Of course this does not include fifteen thousand dollars appropriated for the building of two new hatcheries.

In consequence of the aroused public sentiment and the satisfaction, which members of the legislature have expressed, there is a prospect of a liberal appropriation for next year's work.

In the summary above no note has been made of a very important movement inaugurated by the department, which has every prospect of reaching a satisfactory conclusion next winter, namely: the abolition of water pollution. For years efforts were made by the Fish Commission and others to have laws enacted which would put a stop to this great evil and which was doing more than anything else to destroy fish life in the waters of the commonwealth. Every effort, however, met with crushing defeat through the work of industrial establishments and people interested in their maintenance. It was charged and maintained that all bills introduced were too drastic and would result in the extermination of many industries with accumulated capital of millions of dollars and would even put some small cities and towns out of business, in other words ruin them financially. The new Department of Fisheries made a careful investigation and found many of the allegations true. It took the stand at once, on completing investigation, that the Department of Fisheries, or the commonwealth of Pennsylvania should not destroy any vested industry. On the other hand, that it was not right for these same industries to destroy the fish. It felt also that where industries were established in good faith and under laws which existed, that it was not just for the commonwealth, or for the department to advocate the enactment of laws, which would in effect put an undue burden on those interests. It found the great majority of the owners of industries were in full accord and were ready to support any measure which would in the future prevent the pollution of water and the consequent destruction of fish, provided, it did not practically ruin them or unduly interfere with the existing legal rights. After careful study of the whole situation the department has prepared a bill to meet the issue, and at the same time conform with decisions of the Supreme Court on this very matter. It is a bill to which a large number of manufacturers and persons engaged in pursuits, in which there is waste, dangerous to fish life, express their approval of and which they have promised to support. It has also met the approval of every legislator to whom the draft of the bill has been submitted. In effect it provides that hereafter no new industry shall permit any substance deleterious to fish life to flow into any stream, and that wherever the Department

of Fisheries and the State Board of Health shall unite in declaring that any existing pollution is destructive to fish life and at the same time injurious to human life and animal life, that the nuisance shall be abolished at the joint expense of the commonwealth and the owner of the establishment from which the poisonous substance flows into the stream. By this means, if the bill becomes a law, there will be no new water pollution and existing pollution will gradually be eliminated.

The department feels that one of the very important matters which has engaged its attention has been the experiments to rid the waters of the German carp. On investigating the condition of the waters in Pennsylvania in which fish existed, it found a deplorable state of affairs, excepting in the trout streams. Exception also ought to be made to Lake Erie and the shad fisheries on the Delaware. Everywhere there were reports accompanied by strong proof of a rapidly diminishing supply of many valuable fishes, notably the smallmouth bass. Until less than ten years ago all the principal streams in Pennsylvania were well filled with this fine game fish, as well as other game and food fishes of a lesser reputation. Careful investigation showed that the causes of the diminishing supply were probably from wasteful methods of fishing and the destructive habits of the German carp. Nearly all the waters are literally alive with this inferior food fish, which few people, excepting two classes of the people, will eat. One for the sake of economy and the other because the fish can be killed in conformity with certain religious rites. The department did not attempt and does not attempt to belittle the importance of the German carp as an industry in the market, but it finds that this value does not outweigh the damage which the fish does to other forms of fish life. It has been proven beyond a shadow of a doubt that the German carp is the most destructive fish in Pennsylvania. One carp of twenty pounds weight was recently caught with more than three quarts of spawn of valuable lake fishes within it; and hundreds of other specimens have been captured that show nearly as bad a record for spawn-ating habits. There is almost a universal demand throughout the commonwealth for the extermination of the fish and the legislature has very wisely, the department believes, declared the German carp an outlaw to the extent of imposing a

fine of \$100 on any person, who plants the fish in any waters in the commonwealth. There are other charges equally grave against the German carp, which the department has found to be well founded and which will explain the abnormally rapid diminishing of the black bass supply in the Pennsylvania waters. It has therefore prepared a bill for presentation at the next session of the legislature towards the reduction in numbers of the German carp and, if possible, its eradication from the commonwealth.

The relations between the old Fish Commission and the United States Fish Commission were for many years very close and the Department of Fisheries has labored to make that relationship even closer and more cordial, and it has been met with the warmest kind of response. The department feels that much which has been accomplished during the last year was through the hearty assistance of the United States Bureau of Fisheries. I cannot close this paper without referring to its work in yellow-perch culture and in blue-pike culture. The blue-pike fishing is today the most important industry of the fishermen who go out on Lake Erie from the City of Erie, and the fishermen attribute the abundance of that species of fish to the millions of fry which Pennsylvania hatches annually and plants in that body of water. It also observed that the demand for yellow perch in the Erie, Philadelphia and Pittsburg markets is increasing with each year and further, that there is a corresponding decrease in the supply. The Fish Commission had noticed the same thing and four or five years ago began to propagate yellow-perch in a small way. The department has made preparations to hatch the fish on a large scale. This year it hatched about two millions, which is but a tithe of the number contemplated and required.

In addition to the work enumerated the Department of Fisheries undertook to make an exhibit of the fishery resources of Pennsylvania at the World's Fair in St. Louis. It secured four thousand square feet of space, erected thereon thirty-five aquaria, ranging from four to six feet each and the remainder of the space was occupied by nets, angling appliances, mounted specimens of creatures which prey upon fishes and other objects of interest associated with the fisheries work. The department regrets that the live fish exhibit was not as successful as it hoped.

The disappointment was due in the estimation of the department to the water. Dr. Tarleton H. Bean, who is in charge of the Forestry, Fish and Game Building made every effort to meet the requirements of a good live fish exhibit, and hence any disappointment cannot be placed on his shoulders. The water of the Mississippi river, it need scarcely be said, is, in its normal condition unfit for high grade fishes, such as Pennsylvania has in its lakes and mountain streams. Filtered water at the best cannot be considered as entirely fulfilling the needs of fishes like the brook trout for example, and chemically filtered water is among the most objectionable of methods employed for purification, and the water of the Mississippi furnished for the aquaria was filtered, it is said, by both lime and alum. As a consequence most of the first supply of fish sent to the exposition died with discouraging promptness. Through the efforts of Dr. Bean the water was subsequently filtered by the alum process in a manner which permits the maintenance of fish life. Unfortunately about the time that this was corrected the weather became very warm and the temperature of the water arose to a point where a number of species of Pennsylvania fishes could not live and also at a time when some of the species taken in the second load were about spawning. As a consequence on the Fourth of July there were only sixteen species out of the original thirty-two still alive, and the majority were such hardy species as the catfishes, and the carps, and some of the surviving species had only one or two specimens. Dr. Bean had arranged for a refrigerating plant at the beginning of the exposition in order that there might be a good supply of cold water; but unfortunately the person, or parties, who had the contract, for installing the cold water apparatus, failed to do the work and the exposition officials neglected to compel him to do so. Subsequently Dr. Bean succeeded in inducting the exposition officials to put in a refrigerating plant, and when it is completed it is hoped that Pennsylvania's display of fishes at the World's Fair may be representative of its fish life.

DISCUSSION OF MR. MEEHAN'S PAPER.

Mr. Meehan: This paper was written at the suggestion of one of the officers of the society.

The secretary, Mr. Peabody: I would like to ask Mr. Meehan a question: Is the head of this new order of things in the management of the fisheries department of Pennsylvania practically alone responsible, excepting that four times a year are held meetings of the four commissioners?

Mr. Meehan: That is practically the fact, yes sir. The Board of Fisheries Commission have certain duties to perform, both of protective work and general work, but the management of and responsibility for all work of the department is on the shoulders of the commissioner of fisheries.

Mr. Peabody: This is a very important matter, I think. I know in our state and in the state of Michigan we have studied the question of how to make a fish commission most effective, and also the question of associating the protection of fish with the propagation of fish. In Wisconsin we have settled the matter to our own satisfaction that they should not be associated together, and therefore we have distinct departments.

Mr. Meehan: Our department is distinct from game or anything else—it is fisheries only.

Q. But you do protect your fish, I understand?

A. Yes, that is true.

Mr. Peabody: I think your state stands alone in this new method. It is very interesting to know how successful you have been in your work; and you tell how many fry etc., you have distributed; but I presume there has not sufficient time elapsed to determine what the results, even in restocking your waters and managing this department under this one head, are, as I understand you have been running under plan but one year.

Mr. Meehan: Only one year.

Mr. Peabody: This goes out in the publication of the society and naturally will attract considerable attention. I think many

states in the union are looking to better their system of fish propagation (at least to better the administration part of it) and if your plan is a good one, others will want it.

I should think a fish commission that met only four times a year would be absent minded. I believe such a commission should meet oftener and get more closely in touch with the work of the executive branch such as that done by the superintendents of hatcheries and other superintendents.

Mr. Meehan: I think the members of the Board of Fisheries Commission who are all present except one, will bear me out in the statement that they are quite able to keep in touch with the work of the department.

As to the time when this new order of things was inaugurated I stated in my paper that it was begun a year ago.

Mr. Peabody: We have here representatives from New York and Michigan and also Rhode Island and Connecticut and other states, that have fish commissions quite like the one in Wisconsin, and I would like to hear this matter discussed by them.

Mr. Meehan: There is a danger in a matter of this kind, and that is the danger of politics. If you have but one man there is more likelihood of his being pulled or swayed than if you have half a dozen. There is many a man looking for a job who would see in the salary of the commissionership of fisheries, that it had a certain salary, and would say, "it is good" whether he knew anything about the work or not.

Mr. Peabody: That danger might be averted if we were always as successful in choosing a political commissioner as when the President chose Mr. Bowers who has proved to be one of the most efficient and capable United States Fish Commissioners that we have ever had. (Great applause.)

Dr. Bean: I am from New York and I would like to say something about this carp (great laughter and applause) which my friend from Pennsylvania has declared an outlaw. I have no objection to his calling the carp names, but I want to ask Commissioner Meehan why he limits this outlawry to the carp, when Pennsylvania has 160 kinds of fish and nearly one-third of them

belong to the carp family and are invertebrate spawn eaters? Why not include the catfish, sturgeon and the western trout—the Dolly Varden—known to all the west coast as the worst spawn eater in the whole list?

Mr. Meehan: We do not have him in Pennsylvania.

Dr. Bean: You have the rainbow trout which is another guilty one. There is another spawn eater that consumes great quantities of the eggs of the shad; shall we outlaw him? I refer to the homo sapiens. (Laughter.)

Of course he is not a fish, but he goes around among the fish and we have got to treat all people alike it seems to me. There is a little bit of a thing in Pennsylvania called the Miller's Thumb; he is not as big as a miller's thumb, but his capacity for trout eggs and fry is marvelous. Some years ago the Commissioner of Fisheries of the United States had a live Miller's Thumb down in Washington in an aquarian, and that little fellow ate about 20 trout fry inside of a minute and was still hungry. We have this Miller's Thumb, or blob, or fresh water sculpin, all over Pennsylvania. Of the 160 varieties of fish in Pennsylvania, 100 are fond of eggs. Let us extend this business and get rid of them.

The carp is of course a spawn eater—is an interloper; but the people of New York see fit to buy a quarter of a million dollars' worth from Illinois every year; but that cut's no figure! The Delaware fishermen beg for opportunity to catch them—but that makes no difference! The people of Great South Bay, Long Island, are crazy about the crap, but never mind that! The greatest difficulty I have had with my boatmen there has been to get him off the carp grounds—he was so fond of it! Perhaps it was because they are fond of eggs and he was too—a bond of sympathy between them. (Laughter.)

We ought not to go about the destruction of carp in this wholesale way. It may be true that we ought not to have introduced carp; I think there is a great deal of "acclimatization" so called that had better be left alone; but we have the carp; the fishermen get a lot of money out of him; and it is only fair if we are going to apply legislation to this fish, that we undertake also to get rid of all the minnows, suckers, blobs, and every other

spawn eater in existence. That is a logical conclusion, and discrimination is unfair.

Mr. Meehan: Perhaps the reason why legislation has not been taken against these other fishes the gentleman has mentioned, is, that God put them here in the beginning, while the German carp is an introduced fish, and nature in arranging this matter did not contemplate the unwarranted interference of man, and when the German carp was placed in these waters the balance was broken. I know very well that we have other fishes that are spawn eaters. We know that the eel is destructive, the lamprey will even enter the shad to get at the spawn; nature provided for that. Speaking of the shad alone, if it were not for the upsetting of the balance established by nature, we know very well that the rivers would be filled with shad everywhere.

In regard to the Dolly Varden trout, we do not have it in Pennsylvania unless it has been put in by the national government, and we will not propagate it, and will propagate no introduced fish that we believe to be very destructive.

I have nothing in particular against the German carp; I do not want to eat it—I would sooner eat monkey veal; (Laughter) but I do want to say that while it is a fish that undoubtedly holds a place in the market, while it has a large sale, and while we sell it in Pennsylvania markets to an amount running up to nearly \$100,000 a year in Philadelphia and Pittsburg, yet there is considerable evidence to show that it has destroyed fish that would be worth more money to us. Black bass is worth more to us in Pennsylvania in dollars and cents than the German carp ever could be, and so far as its use for game and food purposes is concerned, the black bass is far superior to the fish that we have put under the ban of the law.

The German carp not only eats spawn but is destroying in many sections of the country, plants that form hiding places for other fishes. Other counts can also be brought against the carp. I have heard it said that there has been no specific evidence brought against the German carp. Now I have seen plenty of specific evidence; I can bring volumes of it from my office, on the destructiveness of that fish. I have seen what the fish have done at various times. I have nothing particular against

the German carp, except as to that one thing; I am not calling it names; I am stating the hard, cold fact that the legislature of Pennsylvania has practically declared it an outlaw by prohibiting the planting of it any longer in our waters.

Dr. Johnson: I cannot enter into an argument like this and call myself anything but a neophyte; but perhaps I stand on a fair, even ground, and for once I can heartily coincide with the gentleman from Pennsylvania, and I take issue at the sweepstakes expressed by the gentleman from New York. It is true that if we begin to exterminate a dangerous factor it would seem to me, as in medicine and in surgery, it is necessary to take perhaps one evil at a time, and take what appears to us to be the greatest evil. If we attempt to kill out every sort of fish that eats spawn, in a very little time we would have nothing left but water.

I do not take issue against the German carp, because in the first place he is a foreigner. He has been introduced in this country, and there was no necessity of it, as far as I can find by reading, or by hearing you gentlemen speak of it.

Now I believe it is right to declare war against him. I am looking at it, gentlemen, not alone from the standpoint of being interested in a very humble way in the propagation or culture of other fishes, but I am looking at it a bit, I might say, from the standpoint of a sportsman. In New Hampshire where I have established a series of ponds which I will speak to you about later, I have seen the brooks depleted, I have seen the ponds bereft, not through enemies piscatorial, but for the want of good laws. I have seen on the other hand, I should say, as great a need in some of the ponds of some of the smaller fish, which no doubt eat spawn when they have a chance, but in turn they are preyed upon by the fish that we call our game fish of America, by the fish that appeals to the sportsman who goes to the woods simple and solely for the recreation, and I hope not for the kill alone. Every protection offered to our game fish in any state I should heartily recommend. If we find that in the various experiments that we have succeeded in eradicating such an evil as the German carp has proven itself to be, then we can begin with other species and slowly but surely relieve our

waters of the natural enemies of the spawning fish classed as game fish, and the ones we care most about to catch. (Applause.)

Mr. Stranahan: I have seen a half pound black bass whip and drive off a 10 pound carp. I do not believe the carp is destructive to the black bass; and in either event he has come to stay. Pennsylvania cannot cut much figure in his extermination, no matter how much she spends.

Mr. Meehan: I have also seen a black bass drive away a German carp and while he was busily engaged in that occupation another carp destroyed the nest that the bass had been guarding.

Mr. Leary: I have seen sun perch drive a tremendous carp from its nest. The idea of a carp taking eggs from a black bass nest is almost incredible. The carp will take an abandoned nest and will undoubtedly eat a great many eggs; but I have 12 big carp in ponds where I am propagating crappie and we never get any crap from this pond showing that the crappie destroy the carp, not the carp the crappie. Suppose you take all these spawn eaters away, what are your bass going to eat? I will answer the question—they will eat one another.

Mr. Atkins: I would like to ask whether Mr. Meehan regards the extermination of the carp as practicable.

Mr. Meehan: No sir, I do not think it can be done. Like certain races of people it is impossible to get rid of them. They are with us to stay.

Mr. Atkins: If it is impossible to exterminate them, I should judge the next best thing would be to eat them. (Applause and laughter.)

Mr. Titcomb: I did not intend to say anything on this carp question. It has been threshed over at every meeting and still it comes up. I was only going to say that it seems to resolve itself into a sectional question; it is a sectional issue. For instance, with our present knowledge of the carp we would not ship them to the waters of Maine, or the waters of Pennsylvania, but there are a great many states in the union where the carp today is a very valuable food fish and where the people enjoy

it on the table; there are places even where they enjoy it as a game fish to catch with hook and line. The United States Bureau of Fisheries continues to receive applications for carp, which, owing to this feeling in certain sections of the country and among the influential classes of sportsmen perhaps, are not distributed any longer: the people who have asked for them then refuse to take any other fish in many instances, and are often quite indignant because they cannot have the carp. Some of them persist until they find out where they can secure the carp, and take them to their own private ponds. But all through the west there are waters that can be made very useful by the introduction of the carp, and which otherwise are practically unproductive. I think I have told this story once, before the society, but I will tell it again. When I was president of a fish and game association, all of the members sportsmen, some of them commissioners from the New England states, others commissioners of fisheries from Canada, 224 in number, we sat down to a table on one occasion and ate carp under the name of baked red snapper; most of them knew they were not eating baked red snapper; some of the old lake fishermen told me they thought they were eating white fish; another one said pike-perch; all declared them delicious. "As you know, a rose would smell as sweet by any other name."

Mr. Meehan: You must have had Rhine wine sauce. (Laughter.)

Dr. Smith: Mr Meehan has given us an interesting account of the wonderful amount of work a state can do in one short year, but it appears to me that he has accomplished too much, and that it would be better if three-quarters of that work could be turned over to states that now do nothing. But our admiration for the Pennsylvania Fish Commissioner and for Pennsylvania fish work does not extend to his black bass, more especially to the small mouth variety; for a black bass (and a small mouth black bass in particular) that would be disturbed in the slightest degree by a carp, is not worthy of further consideration. (Laughter.)

Mr. Miller: A friend of mine while standing on a bridge

looking down into a creek on one occasion saw a sight which goes to show what a smart fish the carp is. The maneuver of the carp referred to in this instance rivals the strategy of the Russians and Japanese in their present warfare. My friend looking down into the creek was watching a female bass guarding its spawn, noticed nine carp preceeding in parade in front of the bass, not one of the carp seemed to pay any attention to the bass until the last one was almost directly opposite the bass, when that carp made a dive for the spawn, and although the bass was only half the size of the carp it showed fight, and while the bass was fighting the offending carp, the other eight carp immediately turned in and gobbled up the entire spawn. This was just a little strategy on the part of the nine. They had planned the whole thing before they started to eat that spawn. (Laughter.)

Secretary: I would like to ask Mr. Meehan if the story that the carp is responsible for the Johnstown flood is true. (Laughter.)

Mr. Meehan: It might be.

Mr. Whish: I take great pleasure in listening to these discussions and forming my own conclusions; and my conclusion on the carp question is, that the American fish culturist, (not the worthy paper of that name but the individual) has received an important lesson from the German carp. He has heard a great deal about the German carp abroad and he brought it over here. I do not know anything about the habits of the German carp abroad, but his habits here are not those of a gentleman among fishes. In our state we have tried to get rid of the carp in some of our waters in this way: We gave a permit to one city council to use the seines of the commission for the purpose of relieving a river of that fish. They took out a carload a day for twelve days, without any appreciable effect on the supply, and then gave it up. In New York, those of us who are interested in the culture of the better class of food fishes as well as of game fishes regret that the carp ever was put in our waters. It would be my judgment, that if carp were to be planted again in this country, with the present knowledge which people have of the carp, its range would be decidedly limited.

Possibly the carp is fit for food. Personally I do not like his looks as a fish and I do not like the looks of the people I have seen buying him in the market. I believe he is a cheap food for a cheap people, and that we ought to teach those people to live on a good American diet, so that they may become better citizens. I do not think we can make good people out of cheap food. (Laughter.)

Now this little matter of commissions is something we have had experience with over in New York state. We have had commissions of five, six and seven, and now have a commission of one. It is my judgment that the single headed commission is the best commission, and I will tell you why. The commissioner is a business man and he does not know anything about the scientific aspect of fish culture. He treats the whole hatchery system, forestry system and game protection system exactly as he treats his own business; he expects to get results from each one of those departments, and if he does not he calls up the gentleman in charge of the delinquent department and wants to know why. In one case he called up a gentleman in charge of a hatchery, who did not seem to be holding up his end, and there is a better man in that place now. (Applause.)

The wonderful success of our United States Commissioner of Fisheries is largely due to the fact that he is an organizer. He gets a first class lot of men for important places and therefore gets first class results—and that is what the people want—too. Put a scientific man at the head of a business enterprise and as a rule science does not bear out its reputation. It is all right for looking into the problems of life, but for getting the cash to work out those problems, it is not worth a cent. Let a scientific man go before a legislative committee and tell them in a general way what they ought to do, and the committee will say, "Look here, you want so much money, what are you going to get out of your work for it that we can tell the tax payers about?" And the scientist is not usually ready with the answer. So it seems to me that when you get down to a business enterprise—and that is what fish culture is, if it is anything; it is the running of a manufacturing plant to produce food for the people—you get the best results from having a trained, active, alert business man as your commissioner, and he will look out that his associates

are men who will get results. That is the way it has worked out in the state of New York. We are too busy over there to pay much attention to the manner in which other states are conducting their work, though we follow them pretty closely and sometimes get some valuable information from them; but our experience has been as I have told you.

Mr. Lydell: I only wish to say that I wish Mr. Bartlett was here. (Applause and laughter.) He would show these enemies of the carp where they are at in four minutes. I think the carp was sent here as a blessing for poor people. The carp are here to stay and all the barrels of money we can open will not destroy them. I like them and am going to keep on eating them! (Laughter.)

Mr. Joslin: What I don't know about carp is a great deal more than I have been told here this afternoon (Laughter) but I wanted to say this: nearly two years ago there were bills introduced in the Michigan legislature to allow the licensing of carp fishing or seining. They finally resolved themselves into one bill allowing seining for carp along the Detroit River, which with the St. Clair River and Lake St. Clair connect Lake Huron with Lake Erie. I did not know anything about whether carp ought to be seined out or not, and a committee on fishing and fisheries were good enough to invite the fish commissioners to come out and tell them what we thought about it. Well we did not think anything about it because we did not know anything about it—whether it ought to be done or ought not to be done. Then came certain people, (who some of them I should judge had been to Pennsylvania) and told us what a destructive fish the German carp was. It seemed to me that representing the fish commission at these meetings I ought to find out if I could in what way the German carp is more destructive than other fish. This I tried to do and I am obliged to say, Mr. President, that after attending seven or eight meetings and after cross-examining every one making these statements, I never got from one of them a single definite bit of evidence that the German carp was more destructive of our food fishes in and around Michigan than any other fish of that nature. Now the fish commission have its consent to a bill passing which would allow the seining of German

carp along the St. Clair River and on the shores of Lake St. Clair, and in a portion of Detroit River which borders on the state of Michigan. I have taken occasion this summer to inquire of the carp fishermen as to what they have found, and more particularly with regard to what effect the German carp has had on the spawning beds of the small mouth bass. Along the shores of Lake St. Clair are probably as many spawning beds of the black bass as can be found anywhere. The gentleman who has done the most of the seining for carp told me that there were so few carp in and around the black bass spawning beds that he did not think it was worth while to run a seine there. Now I have not investigated it, gentlemen, to see whether that is true or not, but I know the man and he is a straight-forward, truth telling man.

It is true that there were some small fishermen who took advantage of the law and they would run their seines along the black bass beds for the purpose of seining the male bass guarding the beds, but they were few in number; and so far as I know (and I think the game wardens will bear me out in so saying) the carp fishermen in seining for their fish for the eastern market do not go where the black bass congregate, and that would lead me to believe that the carp are not particularly destructive of the black bass.

Something has been said about the formation of fish commissions. I have for a long time been personally of the belief that the consolidation of the work of a fish, forest and game commission is a natural one. As our lands are denuded of the forests we all know that the streams become affected, and it seems to me that the officer or board having charge of these matters is naturally very closely allied to and connected with the officer or board which has charge of the propagation of fish, and ought to have charge of the enforcement of the laws for their protection; and while it is not the case in the state of Michigan it has seemed to me that that was the logical, natural way, Mr. President. The three members of the commission meet about twice a month, after having first selected, as we think, as good a man for superintendent as can be found anywhere; and when we get together we ask him what ought to be done for the next two weeks or a month as the case may be. He tells us what ought to

be done and then we order it done. (Laughter and applause.) That is really the size of the work of the Michigan fish commission. In other words, laying aside levity, what we have striven to do is to get as good men as could be found in any part of the country to do the work that we are called upon to do and then see that they do it. (Applause.)

THE WHITEFISH; SOME THOUGHTS ON ITS PROPAGATION AND PROTECTION.

BY S. W. DOWNING.

In attempting to write an article upon this subject, I am aware that the first question that a majority of the members at this meeting will ask themselves is, "After all these years, and after all that has been written upon the subject, what does he expect to get by threshing over that pile of old straw?"

Well I will make no apology for the endeavor, but will excuse myself as the Irishman did who was learning to be a brakeman on a passenger train.

It was his first trip, and in order that he should learn to call out the names of the stations, etc., the quicker, he was instructed to follow the older brakeman through the train and repeat the names after him.

At the first station the old brakeman came through and sang out, "Feryhill; change for Hartlepool, Stockton and Middleborough; change for Spennymoor, Coxhoe and Trimdon; keep your seats going north."

Pat strode after him and shouted in a still louder voice: "Fareyhill: change for Dahore, Umphump, Tootalooral, Diderham; change for Coxcomb, Moorham, Findham, Coldham; kape your seats where you are."

The conductor called him aside and showed him the right names on the time-table.

Pat removed his cap and said politely, "Thank you sor. I caught onto the music, but begorra, I didn't just catch the worrds."

Now I have the music all right, and if I fail in producing just the right words to express myself, you will have to lay the blame to our worthy secretary, because he said "write about whitefish," and of course there was nothing else for me to do.

It will not be necessary for me to give the general description, range local and scientific names, etc., as this can all be found elsewhere, and no better name can be found for this best of all

merchable fresh water fish than just plain "whitefish," and beginning with that I will try to give you some of the details of the work of propagating this fish as it is carried on at the Put-in-Bay station.

The whitefish, like many other fishes, is migratory; its real home being in the deeper waters at the lower end of the lake, where it stays in summer presumably for the purpose of remaining in the cool water and where the food supply is more abundant and in winter, because that portion of the lake rarely if ever freezes over so as to exclude the air, and the temperature of the water at the bottom never falls as low as at the upper end of the lake where the water is shoaler.

About the first of October as the spawning season approaches, the instinct of reproduction prompts it to commence its journey to the shoaler waters at the upper end of the lake where it goes for the purpose of depositing its eggs.

The whole upper end of the lake is dotted with shoals and reefs which are the natural spawning grounds of the whitefish, and as the spawning season in Lake Erie begins from about November 5th to 17th, about the first of this month they commence settling in around the reefs, gradually working their way nearer, until by about the 10th, they have gathered onto the reefs in schools and the spawning season commences.

It is at this time that the work of collecting the eggs for this station commences and men employed for the purpose, are sent out into the different localities or fields, where fishing is carried on, each man being provided with a keg, a pail, a tin dipper and a common tin milk pan.

Upon arriving at the fishery a man goes out with each boat, and as fast as the fish are taken on board they are examined by the spawner and the eggs taken from the live fish. In doing this work what is known as the "dry method" is followed: The the pan which they would do if the pan were entirely dry; the eggs of the female are then extruded into the pan by a gentle but firm pressure of the operator's hand passing down over the belly of the fish; after the eggs are all secured in this way, a male fish is used in the same manner, the milt from the male being extruded over the eggs in the pan, males enough being used to insure a portion of the milt coming in contact with every

egg in the pan, and to insure this the operator thoroughly but carefully mixes them, using either his bare hand or the tail of a small fish for the purpose.

After the eggs and milt have been thoroughly mixed a little water is added the pan allowed to stand a few seconds, and then if the fish are not coming too fast, the eggs are carefully washed free of all milt, after which they are placed in the keg which has been partly filled with water, and thus the process goes on until the entire catch of fish has been handled. But in case the spawning fish are coming into the boat too fast to admit of each pan of eggs being washed by itself, which is often the case, they are emptied into the keg milt and all, and the washing deferred until the eggs have all been taken, when they are all washed at once, the water being changed until the eggs are not only clean and free of all milt and any other foreign substance, but until the eggs have so far hardened that there is no longer any danger of adhesion and the eggs becoming caked in the keg or other receptacle used.

After the eggs are taken in the manner described, if the field in which they are taken is near the station, they are brought in and if sufficiently hardened they are placed in the jars, otherwise they are left in the kegs and the water carefully changed as often as once an hour until such time as they are fully hardened when they are placed in the jars.

While the eggs taken in the fields remote from the station are first hardened and then placed upon cotton flannel trays, the trays placed in a case and shipped to the station. The cases used at this station contain twenty one trays each, the trays being eighteen inches square outside measurement.

Formerly if the eggs had to be held in the field any length of time before shipping, it was the custom to sprinkle the eggs on the trays every day or two, but if the operator is not situated so that he can take the eggs off the trays and wash them and also the trays thoroughly, and repack them again, we think it better to leave them dry.

The objection to the sprinkling is, that the bottom eggs become bedded in the flannel and the wetting causes the eggs to form a slime which soon sours, the eggs become mouldy and

several good eggs adhere to each dead one and soon all are spoiled.

White fish eggs are hatched in glass jars holding about six and a half quarts each, about four and a half quarts of eggs being carried in each jar, and to produce the necessary current to prevent the eggs from matting in the bottom about one gallon of water per minute is used.

The time required for incubation is from 128 to 150 days, the length of time depending upon the temperature of the water. With water at an average temperature of $34\frac{1}{4}$ degrees F. 144 days were required for the eggs to hatch during the past winter.

When the hatching commences, as fast as the fry break out of the shells they flow upward with the current and pour out of the spout of the jar into the trough below, and eventually find their way down into the large fry tanks which are provided with fine brass wire screens placed across the lower end of the tanks within a few inches of the overflow, this allows the water to pass out but the fry are retained.

The fry are then dipped from the tanks placed in cans or kegs provided for the purpose, taken out on a steamer and liberated in the lake, care being taken to place the fry upon the spawning beds where nature would have hatched the eggs had they been deposited by the fish.

Care is also taken to distribute the fry over as large an area as possible so as to avoid putting so many in one locality that there will be a scarcity of food for them, the fry from the Put-in-Bay station being distributed over an area of about eighty square miles.

So much for the propagation of the white fish, and we will now turn our attention to the subject of protection, not that we expect to say anything which will throw much light upon the matter ourselves, but we may be able to say something that will lead to a discussion of the subject by those present who can enlighten us, and also those who shall read the report of the proceedings of this meeting.

A great number of laws have been passed by the legislatures of the different states bordering upon the Great Lakes, some of them wise and some otherwise, but no doubt all were passed with the very best intent for the protection of the different fishes.

Some states have laws providing a closed season during the spawning period, others have laws prohibiting the taking of fish in certain localities during the spawning period, etc., all no doubt intended to work the best results toward the perpetuation of the fishing industry and the supply of food fish for the commonwealth.

Let us first examine the merits of the closed season for whitefish. If the whitefish like the basses, sunfishes and some others, were nest builders, paired and fertilized a large per cent of their eggs, and then cared for them until they hatched, and then protected their young until the fry could care for themselves, then the closed season would no doubt work to the best advantage and accomplish all that is expected of it.

But such is not the case, on the contrary the whitefish is what may be termed a school spawner, swimming over the shoals in schools or singly as the case may, and depositing their eggs haphazard regardless of whether there is a male fish within close proximity or not, and the logical result of this careless manner of procedure is, that but a very small per cent of the eggs thus deposited are fertilized, and as these eggs lie upon the bottom from 128 to 150 days, it naturally follows that a great many are destroyed by becoming covered with silt, moss and other filth, and still more are lost by being eaten by other fishes, water lizards, water fowl, etc., and it is safe to say that not one per cent of the eggs deposited naturally produce fry, and this one per cent stand no better chance of living and growing to the edible size than those produced by the fish culturist and judiciously planted.

The average number of eggs produced by each female whitefish is about 36,000, and the fish culturist hatches an average of eighty per cent, or something over 28,000 fry to the fish is produced, while if this same fish deposits her eggs on the reefs, but one per cent, or 360 fry are produced, giving a difference of 27,640 fry in favor of the fish culturist, or for every million of fry produced naturally, the fish culturist produces eighty millions.

It is however claimed by the advocates of the closed season that not all the fish taken upon the reefs are ripe, and that no eggs can be taken from the green fish, this is true and it is

equally true that no eggs can be obtained from *any* of the fish caught before the spawning season.

But it is a fact that of the fish caught on the reefs during the spawning season, from fifty to seventy per cent are spawning, and putting it at the lowest estimate, we then have an increase over nature of about 13,829 fry to the fish, or where nature produces 1,000,000 fry we produce 40,000,000, besides giving employment to hundreds of men, and furnishing a supply of the very best food to the people.

Now if the above statements are borne out by the facts, and it is a good thing to have a closed season at all, why would it not be better to prohibit fishing during the months of July and August, at a time when it is next to impossible to get the fish to market in a wholesome condition, and allow the fish to be taken during the spawning season, when the greater per cent of the eggs can be secured and hatched and the resulting fry returned to the water, thus securing to a certainty the perpetuation of the industry, and furnishing a large supply of one of the most wholesome foods that nature has bestowed upon man?

At the close of our meeting at Woods Hole last year, a number of us were permitted to visit several of the private trout farms where they make a business of rearing fish for market, and supplying eggs and fry to others who are going into the business or who are desirous of stocking streams, and it was noticed that at each place the plant was equipped with a hatchery, rearing ponds and all the equipment necessary to carry on the work of propagation.

Now, if it is better to have a closed season in order to let the fish reproduce, why have these men gone to all the trouble and expense of erecting hatcheries, supplying themselves with apparatus, etc., for the work? Why not, when they have the fish, the stream and everything under their own control, keep away and allow the fish to reproduce in a natural manner and in large quantities? Why? Because these men are in it for profit and they know that if they trust to nature their stock will be extremely small, and their profits correspondingly light.

But, says the protectionist, "Do you not then believe in any form of protection for the fishing industry?" Certainly we do. We believe in having laws made for the protection of the fish, and

believe in having said laws made very simple and binding so that there shall be no misunderstanding, and after they are made have them strictly enforced with a penalty sufficiently heavy to effectually prohibit the probability of the same person committing the second offence.

However we realize that it is a pretty hard proposition to enact a general law for the protection of the fishing industry of the Great Lakes that will not work an injustice to some one, as the local conditions are so varied, that the regulations which would be all right and just in one locality, if enforced in another would drive the fishermen out of business.

But we believe that a law might be enacted and made interstate and international which would work a hardship to no one, be just to all alike and yet be almost a perfect protection to the industry, and that would be to simply have a size limit, making the limit large enough for each variety of fish, so that every fish retained for market or for the table shall have had a chance to spawn at least once, all fish under the size limit to be returned to the water with the least injury possible.

With such a law, with a heavy penalty for having undersized fish in one's possession, with a fearless officer stationed in each port where fish are brought for sale to enforce it, so that the slaughter of immature fish would be effectually stopped, and the work of propagation still carried on to the fullest degree, we believe that but a short time would elapse until the effect would be plainly seen and the lakes again teeming with all kinds, and especially with this the best of all fresh water fishes.

JAPAN, THE PARAMOUNT FISHING NATION.*

BY HUGH M. SMITH.

[ABSTRACT]

When Fish Commissioner Bowers directed me to go to Japan to look into the fisheries and related industries, and thus conferred on me the honor of being the first American detailed for this service, I was already aware of the general importance of the fishing industry of that country and was well informed on some of its phases; but I was not prepared for the wonderful developments which I met with in all parts of Japan. Quickly dispelled were any lingering doubts I may have had as to whether I could learn anything of really practical application to the United States fisheries, and before I left I was firmly convinced that there is no country from which we and other western nations may learn more about fishing matters.

My unfamiliarity with the language might have been a serious drawback, but it really proved a blessing; for the Japanese government came to my relief in a most unlooked for and most generous manner. Experts of the Imperial Fisheries Bureau, some of whom I had already met in America, were detailed one after another to act as guides, companions and interpreters; and on my entire visit, during which I travelled 5,000 miles within the country, I was accompanied by officials well acquainted with the different regions and their fisheries. Furthermore, in every province where fisheries were to be inspected the local government received orders from Tokyo to make advance arrangements for the foreigner's coming, and to detail an assistant in the fishery department to remain with the party as long as it was in that particular province.

In asserting that Japan is the leading fishing nation, I am aware that its fisheries are exceeded in value by those of two or three other countries, but Japan is pre-eminent—

1. In the actual number of people making a livelihood by fishing.

2. In the relative numbers of persons engaged compared with the total population.

* This article, with accompanying illustrations, is published by permission of Hon. Geo. M. Bowers, U. S. Commissioner of Fisheries.

3. In the relative importance of fishery products in the domestic economy.

4. In the ingenuity and skill shown by the people in devising and using fishing appliances and in preparing fishery products.

5. In the extent to which all kinds of water products are utilized.

6. In the zeal displayed by the government in promoting the interests of the fishing population.

Complete statistics of the Japanese fisheries have not been published, and many details that one would like to know are inaccessible. Statistics of the catch, however, are fairly complete and are alone sufficient to place Japan in the front rank of the fishing nations. The annual value of the water products is now about \$30,000,000. The fishing vessels and boats number nearly 500,000, of which about 18,000 are more than 30 feet long, and 85,000 additional are more than 18 feet long.

One-twentieth of the entire population is fishermen. The latest figures available give 940,000 professional fishermen and 1,400,000 who devote a part of their time to fishing and a part to agriculture or other pursuits, a total of 2,340,000, as against 150,000 in the United States.

The factors which underlie Japan's greatness as a fishing nation are numerous, and some of them have already been suggested, such as the ingenuity and industry of the race, and the spirit of frugality which results in the saving of every product of the water. The geographical features have, of course, been potent in developing the fisheries—the numerous islands and the great length of the coast line (estimated at 30,000 kilometers) bringing a large part of the population within easy reach of the sea, so that there is scarcely any part of the empire where fresh fish may not be had daily and this too without the aid of railroads and ice. The extension of the empire diagonally through 35 degrees of latitude and 38 degrees of longitude is accompanied by a wonderful variety of water life, upward of 1,000 species of fishes being already known, and other classes being correspondingly well represented. To all of this is to be added a great abundance of most useful products, some peculiar to the inshore waters, others high-sea species which come close

to the coast in immense droves and are perpetually renewed, owing to the presence of water several thousand fathoms deep within a few miles of the main land.

To the attitude of the government must be attributed no small share in the development of the fisheries. Since the Restoration, the control of the industry has been vested largely in the central government; and everything has been done that the most enlightened civilization could require to promote the welfare of the fishermen and the growth of the business. With characteristic progressiveness, officials have been sent to America and other countries from time to time to study fishing and fish culture, and the best methods of foreign lands have been adopted by the Japanese so far as applicable to local conditions. The Imperial Fisheries Bureau, a branch of the Department of Agriculture and Commerce, is splendidly organized and ably administered by specialists in biology, fish culture, economic fisheries, and law who can hold their own in any gathering. The work is conducted on modern lines, with great stress laid on scientific investigation as the basis for fishery legislation and promotion.

The imperial government, and the various local governments, appreciate the importance of experimental and biological stations in connection with the fisheries, and many such stations have been established and are now doing excellent work. Most of the stations or laboratories are completely equipped with canning and other apparatus, and experiments are constantly in progress to develop methods of preserving all kinds of aquatic products.

An institution to which the Japanese can point with great pride, and about which I should like to talk at some length did time permit, is the Imperial Fisheries Institute, located in the outskirts of Tokyo, on Tokyo Bay. I had the honor of being permitted to give a talk before the faculty and students of the institute on the fishery work of the United States. Upon being shown about the place and seeing something of the equipment and methods, I was completely overwhelmed, and had no hesitation in asserting that no other country had a similar institution which could compare with this one in comprehensiveness of curriculum, thoroughness of instruction, and complete-

ness of equipment. The plant covers nearly 9 acres, of which the dock occupies $1\frac{1}{2}$ acres and the buildings over 2 acres. The work extends over three years, and has three courses, any one of which may be selected for special study by students in their third year, each course occupying 10 full months. The department of fishing includes the following subjects in its regular curriculum: Methods of fishing, navigation, seamanship, ship-building, meteorology, oceanography, applied mechanics, applied zoology, applied botany, mathematics, law, economics, book-keeping, elementary fisheries technology, and English. The department of fisheries technology has special instruction in marine food products, marine industrial products, bacteriology, applied mechanics, industrial chemistry, chemical analysis, applied zoology, applied botany, law, economics, bookkeeping and English. In the department of pisciculture, the subjects are fresh-water culture, salt-water culture, protection of fish, embryology, bacteriology, oceanography, chemistry, applied zoology, applied botany, law, economics, bookkeeping, and English. Provision is made for post-graduate investigations and for various special technical inquiries. The institute has an annual income from the government amounting to \$70,000, and several minor funds; and has numerous graduates, most of whom obtain excellent positions as directors of fishing, fish-curing, and fish-cultural establishments.

The Japanese Fisheries Society deserves mention. It was organized about 25 years ago, and has done excellent work directly and in co-operation with the government. It publishes a monthly journal, and has 4,979 members.

It will, of course, be impossible in a short time to do more than present a brief general outline of the Japanese fisheries, and then to note particularly a few of the more 'attractive or important branches or phases of the industry.

While the Japanese high-sea fisheries, for cod, halibut, whales, fur-seals, etc., are important, and while the river and lake fisheries yield considerable quantities of products, the shore fisheries alone give to Japan its prominent and unique position as a fishing nation.

Of the most valuable products, many are identical with or similar to ours, the principal difference in the fisheries of the

two countries being in the relative extent to which particular animals are utilized. Herring is king of fishes in Japan, just as it is in some European countries and in the world considered as a whole. This fish is worth \$4,000,000 yearly to the Japanese, and is particularly abundant in the northern provinces. Next in importance come the sardines, valued at \$3,700,000; they are extensively canned, and are also eaten fresh and sun-dried. Their bonito, very similar to ours, ranks third in value, the annual sales being \$2,000,000. It is prepared in a peculiar way, and is always kept on hand as an emergency ration in Japanese houses. A fish similar to our scup or red snapper and known as the tai is the favorite fish for fresh consumption, and is worth about \$2,000,000 yearly. Other prominent products are mackerel (\$1,000,000), tunny or horse-mackerel (\$900,000), amberfish or yellow-tail (\$1,000,000), squid and cuttle-fish (\$1,500,000), anchovies (\$800,000), prawn (\$700,000), and salmon (\$600,000).

The Japanese have no fisheries comparable with our shad, alewife, menhaden, striped bass, white-fish, pike perch, lake trout, soft crab, lobster and sponge fisheries. Their oyster and clam fisheries are insignificant by comparison with ours; so, too, are their salmon, mullet, cod, halibut, whale and other fisheries. On the other hand our herring, sardine, anchovy, yellow-tail, tunny, squid, prawn, abalone, shark, bonito, and sea-weed fisheries are trivial compared with theirs; and we have no cuttlefish, sea-cucumber, and coral fisheries. The recent growth of the Japanese coral fishery has been marked, and the Mediterranean corals which for centuries have monopolized the world's markets have already taken second place; much of the Italian output of coral ornaments is now made from imported Japanese raw products.

For weeks at a time I was away from towns having European hotels, and lived at Japanese inns in strictly native style, sleeping on the floor, receiving callers while kneeling on the floor, and eating while sitting cross-legged on the floor before miniature tables, my wants supplied by more polite waitresses than one ever meets in any other land. A typical Japanese meal abounds in products of the water, and is replete with surprises to the unsophisticated foreigner. This is particularly true of the smaller fishing villages where I passed many days.

When it comes to eating water products, the Japanese have few prejudices. If any species of fish are discarded, they must be very few indeed and I learned of none. Among their commonest, cheapest and most wholesome food-fishes are sharks, which are brought into the markets and butchered much after the manner of beef in our country. For some reason we do not knowingly eat sharks, and thereby miss a good deal. As some of you are doubtless aware, the dog-fishes, which go in such immense droves on our east coast and are so destructive, are excellent when fresh or canned; and I predict that the day will come when these and other sharks will be regularly seen in our markets.

Raw fish is one of the national foods. I acknowledge that my repugnance to it was great, but it was overcome with the first dish, for as prepared and served by the Japanese the thin, cold, boneless slices of perfectly fresh tai or mackerel, taken with chop sticks and dipped in soy-bean sauce, are delicious.

Other articles which I have eaten at a single full-course dinner are fish soup, fried fish, baked fish, fried eels and rice, pickled eggs of sea-urchins, dried octopus or squid, boiled abalone, sea-weed jelly, and shredded whale cartilage, pickled.

A characteristic scene in the larger coast towns is a crowd of men, women and children searching and scraping and digging with hand, or stick, or rake, on the shores at low tide for any little fish, or shell, or crab, or bit of sea-weed that may serve as food. In Yokohama, where I first saw this practice, swarms of poor people appear on the beach at each period of low water, and seldom fail to carry home with them enough of the bounty of the sea to serve for several meals. A very striking sight is some times afforded by the bright garments of the women and girls, who even though their kimonos may be plain, usually affect gay obis and underskirts. At low tide, boats resort to the marshes and bars for the purpose of gathering any kinds of products that may have been stranded or that may be accessible by wading.

Fishing vessels and boats are of various patterns, according to the region, fishery, etc.; but all those used in marine fishing are alike in being very strongly and heavily built, many being almost clumsy from our standpoint. They are often constructed throughout without the use of nails, and are not painted. The

boats are for the most part arranged for sculling instead of rowing, and their crews are large. Human labor is one of the cheapest commodities in Japan. It is no uncommon thing to find eight to twelve men constituting a boat's crew, whereas with us a similar boat and fishery would require only three or four men. The sails are frequently of the junk rig, and sometimes consist of five or six upright widths of straw matting loosely laced together.

The fishermen venture far off shore in small open boats,



FISHING BOATS WITH LARGE CREWS.

sometimes as much as 75 miles, in quest of certain pelagic fishes. The first intimation I had of the proximity of the Japanese coast on the voyage from San Francisco was the sight of small fishing junks, many of them with women in their crews.

The Japanese fishermen are hardy, ingenious, capable, sober, brave and patriotic. In view of recent developments in Manchuria, Korea, and on the seas, it is proper to mention that the prowess of the Japanese on land and water is due in no small degree to the skill, bravery and loyalty of the fishermen. When

volunteers were called for to take vessels into Port Arthur for the purpose of blocking the channel, those who insisted most strongly on being allowed to go to almost certain death were the coast fishermen; and in every naval achievement of the present war, the fishermen in the navy have played a prominent part.

Ingenious and important uses are made of many products which with us are mere curiosities. Nothing would seem to us to be of less value than the dried strings of egg-cases of whelks which are so common on our sandy shores; and yet, in Japan, I



IMMENSE BAMBOO BAIT-BASKETS.

saw many street vendors with push-carts loaded with these objects, dyed a bright red or other color and tastefully arranged on masses of wet sea-weed; and I saw many half-grown girls buying them and making a blowing noise by putting them between their tongue and palate.

In a town near Tokyo, I saw a shop devoted to the manufacture and sale of lanterns made from the dried skins of swell-fish. In the Loo-choo Islands, water snakes are a common article of food. They are prepared for market by drying in an extended or slightly wavy position. Those I saw were about a yard long.

The bamboo plant, which grows all over the country and is widely cultivated, is useful in the fisheries in numerous ways. Live-cars or baskets for sardines and other small fishes employed as bait in the line fisheries are usually made of bamboo. Some of them are colossal; one I saw drying on the beach in a southern province was 10 feet in diameter.

The Japanese have a great many national holidays. One of them is devoted to girls, and another, in May, is the special property of boys. Besides the games and festivities which pertain especially to boys, a peculiar feature of this holiday is the throwing to the breeze, from nearly every house, of hollow paper and cloth fishes, some of them 20 feet long.

The octopus or devil-fish is abundant, and is an important food-product, although my personal opinion is that it does not appeal strongly to the American palate. The octopus is caught in various ways, one of the most interesting of which is by the use of earthen-ware pots, which are lowered to the bottom by means of cords; they are entered by the octopuses, which having insinuated themselves are reluctant to withdraw, so that the pots may be pulled to the surface before the animals try to escape. I bring up this fishery in order to refer to a very ingenious corollary, which was first mentioned to me by a professor in the imperial university and later verified by myself. More than a century ago a vessel laden with a very valuable cargo of porcelains from Korea destined for the imperial household was wrecked in the Inland Sea; the captain and other officers did what seems to have been a favorite amusement of the olden days, namely, they committed suicide just before the vessel sank in deep water. Recently the fishermen have been recovering pieces of this pottery, which now has an appreciated value, by tying strings to octopuses and lowering them in the vicinity of the wreck. The animals enter the vessels and retain their hold of them while being drawn to the surface. Several pieces of this porcelain which I saw were gems, seeming but little the worse for their prolonged submergence.

Japan has an abundance of frogs. Every one of the million or more rice fields, with its numerous ditches, is a natural frog farm, and the croaking of frogs is the characteristic sound outside the cities; but, singularly enough in a country where few

resources are neglected, frogs have no market value and are never used except as delicacies for sick children. On thinking about this matter, however, it has occurred to me that perhaps the frogs are much more valuable as destroyers of insects injurious to the rice plant than they would be as food. In the rice ditches and reservoirs, carp are very extensively grown, and various small fishes also occur and are caught with scoop nets or short seines.

The cultivation of water products has gone hand in hand with the development of the fisheries, and in certain lines has attained greater perfection and extent than in any other country. The culture of terrapin, which with us is an unsolved problem and has only recently been seriously approached, has been very successfully carried on for years by the Japanese. I visited a terrapin farm near Tokyo where 40,000 young were hatched last year and 10,000 large terrapins were reared and sold at an average price of 40 cents a pound. The Japanese oysters are of excellent quality, and are extensively and ingeniously cultivated, as shown in a special report recently issued by the Bureau of Fisheries. The artificial propagation of food-fishes is not as yet important and is practically restricted to salmon in the island of Hokkaido and to carp in all sections.

The fish whose cultivation engages more people than any other species is the gold fish. The attention given to this species illustrates one of the characteristic racial features of the Japanese—namely, the love for the purely beautiful or ornamental which pervades all classes, and the time and money they bestow on things that appeal to the esthetic rather than to the mercenary and practical, notwithstanding a large part of the population is and always has been pitifully poor in this world's goods. The demand for gold-fish appears to be without limit, and every year the output shows a substantial increase. Many thousand people make a livelihood by growing gold-fish for market, and hundreds of peddlers carry the fish through the streets and along the roads in wooden tubs suspended from a shoulder-bar. The leading gold-fish center is Koriyama, not far from the ancient capital city of Nara. Here are 350 independent breeding establishments, whose yearly output runs far up into the millions. One farm at which I spent some time was started 140 years ago,

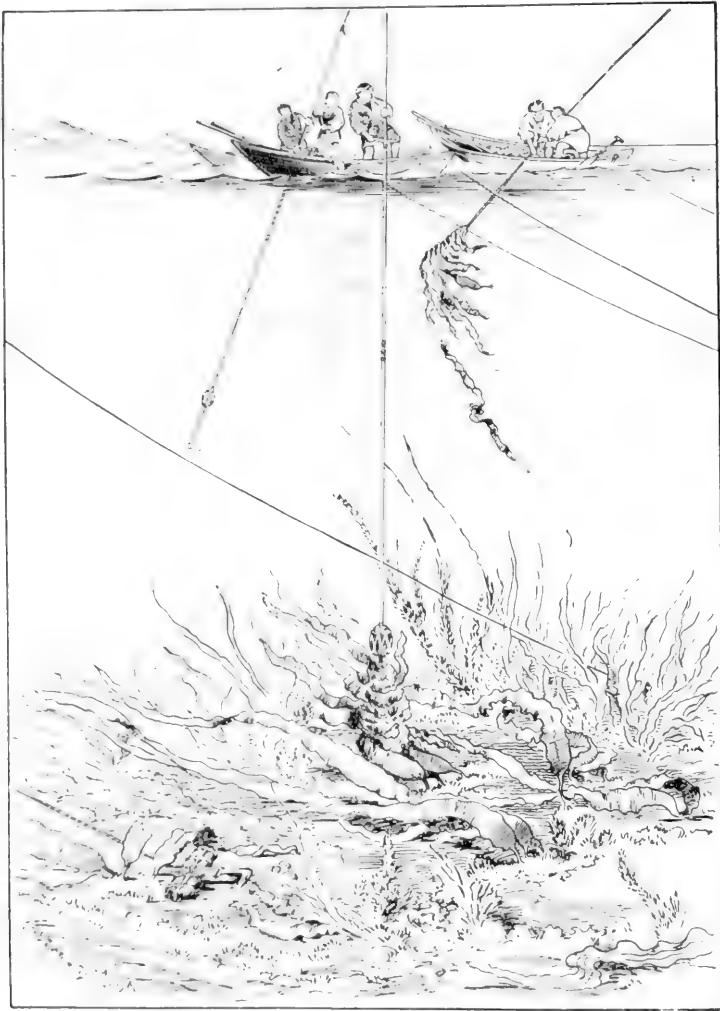
at first for the mere pleasure of the owner, but later it became a commercial enterprise and is now very profitable.

The history and methods of gold-fish culture in Japan make a very interesting subject to the fish-culturist, biologist and ethnologist; and I wish I had time to dwell on it. Some of the American ideas as to the way in which the different varieties are produced are preposterous and caused much mirth among the Japanese when I mentioned them. On this point I need only say that the results are due to selection and feeding, through many generations, beginning with the wild, carp-colored form which is abundant in lakes and ponds.

A branch of the fisheries in which Japan far surpasses all other countries as regards both extent and methods is the sea-weed industry. In the United States, notwithstanding our long coast line and sea-weed resources not inferior to Japan's, the annual crop of marine vegetables is worth only \$40,000, whereas in Japan these products are worth not less than \$2,000,000, and are exceeded in value by only four animal products of the fisheries. Many kinds of algae are gathered, and many uses are made of them. The local consumption is enormous, yet large quantities of prepared sea-weeds are exported to China, America, Europe and elsewhere.

One of the most valuable kinds of sea-weeds is the kelp, or *Laminaria*, which is taken in immense quantities on the more northern coasts, particularly in the island of Hokkaido. The fishermen go out in small boats and gather the weeds from the rocks by means of long-handled wooden hooks. The plants are spread flat on the beaches to dry, and when thoroughly cured are packed in bundles and sent to manufacturers in various parts of the empire, by whom it is prepared for market in a great variety of ways, under the general name of *kombu*. *Kombu* is one of the staple foods of the country, entering into the dietary of almost every family and being eaten alone as a vegetable or as a seasoning for meats, fish, stews, etc. One of the commonest methods of preparation is to dye the dried fronds with a solution of copper sulphate or a green aniline stain, for the same reason that French peas are dyed, and then cut them into long shreds which, when dry, resemble the so-called "Spanish moss" that festoons trees in the Southern States. After the shredded weed

is thoroughly dried in the open air, it is baled for shipment, much of it going to China. This business has been carried on



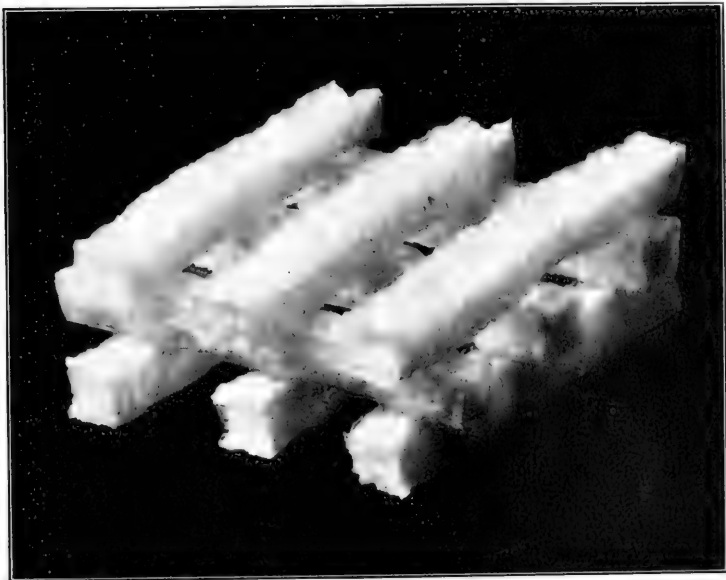
GATHERING KELP IN HOKKAIDO.

since about 1730; employs thousands of men, women and children; and is worth from \$500,000 to \$1,000,000 a year.

Various algae with soft, pulpy fronds are dried by the fisher-

men and sold to dealers for manufacture into a kind of glue. The weeds are soaked in fresh water, made into thin, loose-meshed sheets, and rolled like Japanese matting. When ready for use, such sheets are boiled in fresh water, and the pasty mass resulting is employed as a starch for clothing, in stiffening fabrics, in cementing walls and tiles, and in other ways. This business dates from about 1670, and is now conducted in over 100 establishments.

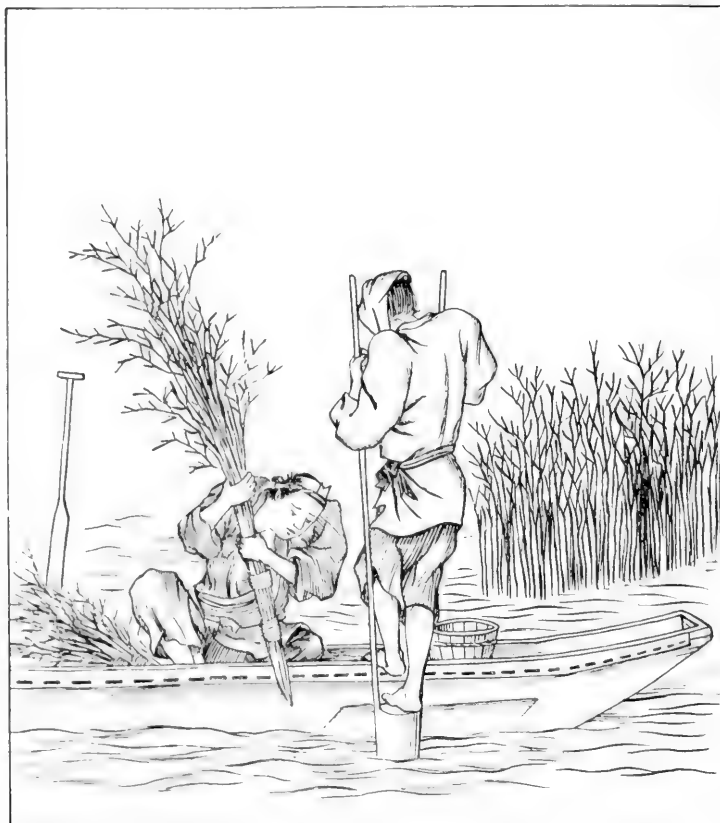
A very interesting and valuable sea-weed product, and the



BARS OF VEGETABLE ISINGLASS.

one with which Americans and Europeans are most concerned, is vegetable isinglass, or agar-agar. It is made from weeds rich in jelly by boiling in fresh water and straining the pulpy mass through coarse cloths. For convenience in handling, the pulp is formed into slender sticks about a foot long, which are used locally in making food-jellies or are exported to Europe and America for use of bacteriologists in making culture media; or the pulp is molded into bars a foot long and $1\frac{1}{2}$ inches square, which are sold almost exclusively in Holland for use in clarify-

ing liquors. The Japanese name for this product is *kanten*, meaning "cold weather," in allusion to the fact that it can only be prepared during winter, as a low temperature is necessary for the solidification of the jelly. Five hundred establishments are devoted to its manufacture, and the output in 1902 was 3,000,000 pounds, valued at \$750,000. The identical alga from which



PLANTING BRUSH ON WHICH THE LAVER IS TO GROW.

the Japanese make their *kanten* abounds on our coasts, but not a piece of it is now utilized. I cannot believe that our coastwise inhabitants will much longer neglect this valuable resource, which yields a high-priced, easily-made product whose gelatinizing properties exceed those of any other known substance.

One other sea-weed must be referred to because the supply comes almost entirely from planted grounds, and in the cultivation of marine vegetables the Japanese stand alone. In all parts of the world there occurs a red alga known to British and Americans as laver, which was formerly a popular food in the British Isles and sparingly eaten in the United States. From a



SPREADING AND DRYING LAVER ON MATS.

very remote period the Japanese have utilized this plant, and for centuries—just how long is not known—have carried on an ingenious form of cultivation. In fall, arrangements for the sea-weed crop are made by sinking into the muddy bottoms of bays numerous bundles of brush or bamboo. These bundles, which are prepared on shore and taken to the grounds at low

tide, are planted in regular lines, deep holes being made for them by means of an elongated conical wooden frame, with handles, which is forced into the mud by the weight of the fisherman. The brush intercepts and affords an attachment for the sea-weed spores, which grow so rapidly that by January the plants have attained their full size and the cutting of the crop begins. The plants die about the time of the vernal equinox, and the active business is at a standstill until the ensuing autumn. The best grounds for the cultivation of laver are in Tokyo Bay, and are



YELLOW-TAIL NET AND BOATS.

leased by the government. In 1901 the area planted with brush was 951 acres, and the value of the crop was over \$148,000, or \$156 an acre. In 1903 the same area yielded \$300,000, or over \$310 an acre. The total area of cultivated grounds in the whole of Japan is about 2,300 acres, and the value of the sea-weeds grown thereon is \$400,000 to \$500,000. About 3,500 families are engaged in this form of aquiculture. Small quantities of the laver are eaten fresh, but most of it is sun-dried before it reaches the consumer. The weeds are washed, picked, sorted,

and then chopped fine by hand; and the wet, chopped pieces are spread on small bamboo mats and pressed by hand into thin sheets, the mats being placed on inclined frames in the open air. When drying is complete, the sheets are stripped from the mats, piled and pressed, and tied into small bundles for market. This product has numerous culinary uses, and is found in every Japanese kitchen.

Reference has already been made to the importance of the amber-fish, or yellow-tail. Along the southern shores of Shikoku,



ONE OF THE BOATS IN THE YELLOW-TAIL FISHERY.

one of the five main islands, the taking of yellow-tails is the chief fishery, requiring a large outlay of capital and employing many men. The apparatus used is a huge bag net, with long straight wings. When a school of fish has entered the net, the boats close in, the fish are driven into the bag, and are finally pocketed. I believe I am safe in saying that the yellow-tail nets are larger than any other set-nets in the world and require the services of more men. Each net is tended by 25 or 30 boats, including a look-out boat with an elevated perch; and 150 to 200

men are in constant attendance. A net which I visited and saw drawn had two wings, each 3,000 feet long, one of them extending to the shore: the bag was 900 feet long, 250 feet wide at its mouth, and 125 feet deep. During a season of $2\frac{1}{2}$ months, this net had stocked \$50,000, which was an ordinary catch. On one occasion 10,000 yellow-tails, averaging 20 pounds each, were taken at one haul. There is only one yellow-tail net in each village, and in many cases it is almost the sole source of wealth to a community. In five or six years some of the poorest and meanest villages have been made rich and undergone striking internal improvements as the result of the establishment of yellow-tail fishing. When the haul of the net in question was completed and we were about to steam away, the captain of the crew came alongside and presented a fine yellow-tail, a large tai, and several bonito, which were cooked on the run back to port.

Of all the fresh-water fishes of Japan none is more interesting than the *ayu*, or dwarf salmon. It is found in the mountain rivers throughout the empire, and is an important food and game species. Its introduction into certain American waters would be very desirable, and I strongly recommend that its acclimatization be attempted. Following are some of the points in the life history of this really remarkable fish, about which very little has been written:

It spawns in fall, at night, in the lower courses of rivers, on gravelly riffles. The eggs are attached to the gravel, and immediately after attachment the outer shell ruptures and becomes everted. Hatching takes place in three or four days, and the young go to sea, remaining in the vicinity of the rivers until spring, by which time they have become two or three inches long. Then they run up the streams, going to the upper waters and reaching full size by August. In the young fish less than two inches in length, there are conical teeth in the jaws, and copepods, flies and insects generally are eaten; fish about two inches long lose their teeth, they cease to eat animal food, papillae especially adapted for scraping algae from stones develop on the lips, and ever afterward algae constitute the sole food. The species reaches maturity when five inches long, and its maximum length is a little over ten inches. When just a year old, it drops down stream, spawns and dies.

The ayu takes the fly readily, and is caught for market in various kinds of contrivances, but the most interesting fishery is that carried on with trained cormorants. Most of you have doubtless heard of this fishery but perhaps you have thought, as I did, that it was a good deal of a myth. With us cormorants are about the most useless of all water birds; but from a very remote antiquity—certainly for 1,000 years—the Japanese have employed cormorants for catching ayu on some of the clear mountain streams.

At the time of my visit to the most celebrated of the cormorant fishing villages, in the outskirts of the large city of Gifu, the outlook for fish was not good and the fishermen had decided not to go out that day; but the governor of the province had been notified of my coming by the central authorities in Tokyo, and did something which would be quite unthinkable on the part of a governor of one of our states—he ordered the fishermen to fish, and they did so! He also had taken for me an excellent and unique series of photographs from which the illustrations have been made.

The most expert of the cormorant fishermen and trainers, whose ancestors for many generations had engaged in this fishery in the same locality, attired himself in the peculiar dress of the profession for the purpose of giving a special exhibition of his birds and the method of handling them. In preparing the birds for fishing, the first step is to put a cord around the lower part of the gullet, so that the fish which they catch may not pass beyond a point whence they may be resurrected. You can readily understand that it is a delicate operation, as too tight a cord will injure the bird and too loose a one will enable it to swallow the fish. The cormorants are controlled by a cord about 14 or 15 feet long attached at the back of the neck, the first part of the cord consisting of a stiff piece of whalebone upwards of a foot long, the function of which in preventing the tangling of the cord is easily understood.

The boats are of a special type, being long, narrow dugouts, propelled primarily by paddles, but when *en route* to the fishing grounds a sail is often used. Unfortunately for the photographer, the fishing is done at night, and you can see on the screen not the real operations but only imitations. Late in the after-

noon the boats start for a place in the river where fishing will begin, the cormorants stowed away in pairs in large, circular bamboo baskets. The fishing grounds cover many miles, and successive sections of the river are fished nightly, some stretches



CHIEF OF THE CORMORANT FISHERMEN.

of several thousand yards being set aside as imperial preserves where no fishing is permitted.

Each boat has a crew of four men and a complement of sixteen cormorants. As soon as darkness prevails, a blazing fire of pine wood is kindled in the iron basket over-hanging the bow of the boat. The birds are dropped overboard and the boats drift

down stream in a line, each guided by two men. The captain manages twelve cormorants and his assistant four. With the birds diving and darting in all directions, those of different boats mingling, it is a wonder that they do not soon become inextricably tangled; but so skillfully are they managed that the lines



A TRAINED FISHING CORMORANT.

rarely become fouled. In a surprisingly short time the cormorants' gullets begin to bulge with fish; when they are well-filled, the birds are pulled up to the gunwale of the boat one by one and their catch is gently squeezed out into baskets, the fish usually being still alive. This is continued for several hours,

and each cormorant may have filled its pouch fifteen to twenty times.

A spirit of intense enthusiasm fills men and birds alike; and the shouts of the fishermen, the croaking of the birds, the rush of the mountain stream, the splashing and creaking of the paddles, the hissing of the embers as they fall into the water, the weird lights and shadows, combine to make a performance which a westerner is not likely soon to forget.

Spectators usually go to the fishing grounds in a kind of



CORMORANT FISHERMEN BOUND FOR THE FISHING GROUNDS.

barge, illuminated by the soft light of lanterns and well stocked with eatables, which are daintily served by dainty maids. On the night when I had this unique experience, the boats averaged 800 fish apiece, and the seven boats in whose operations I was particularly interested caught fish worth \$150—a very large sum to Japanese fishermen. The catch was largely ayu, four to eight inches long, some of which I had for breakfast next day. The highest praise for these fish which I feel safe in proclaiming is that they were as delicious as brook trout.

Shima is the Rhode Island of Japan, being the smallest of all the Japanese provinces; and it has been celebrated from the earliest times, not for its clam bakes, but for its women divers, who are among the most expert of their class and among the most interesting people of Japan, inheriting through many generations an aptitude for water life which makes them veritable human ducks. During a considerable part of the year they are in the water from five to seven hours daily, coming out about three times to warm themselves by fires kindled on the shore.



DEMONSTRATION OF CORMORANT FISHING.

The chief objects of their pursuit are pearl oysters, which abound in the clear, cold waters of this province. Gradually the valuable pearl-oyster grounds have passed into the possession of one proprietor, who is engaged in the growing of pearls by artificial means and employs most of the divers. Those of ordinary ability receive the munificent salary of ten to twenty cents a day; but the most expert, like those clad in white who are giving a special exhibition for my benefit, are paid as much as thirty cents. Each diver has a tub in which the pearl-oysters are dropped as they are brought up. The average length of time the

divers remain down is a little less than a minute, and the maximum about 1½ minutes, during which time they collect four to six oysters. One girl will gather 300 to 500 shells in a day, in water four to six fathoms deep. On coming up and preparing to make another plunge, they make a prolonged, shrill whistling sound, produced by the deep and rapid inspiratory effort. When fifty or more divers are in the water at one time in a small area, their peculiar whistling is almost incessant.

Not the least interesting thing about these women is their



WOMEN DIVERS. PROVINCE OF SHIMA.

personal appearance. They are extremely hardy and powerful, and even the responsibilities of maternity interfere with their occupation for only a short time; but they age very quickly; their skin becomes rough and coarse; their hair turns red; and extreme ugliness is their inevitable lot. When not in the water, they are attending to their scarcely less arduous work in the fields. They support the male members of their households, who pass their days in lazing, smoking, and chess-playing, and are in all respects inferior to the women.

The proprietor in question has patented a method of inducing an artificial growth of pearls in these mollusks, and has built up an exceedingly important business. He employs 100 people, has about 100 acres under active cultivation and many hundred acres on which to draw for his supply of mullusks for inoculation, and has about 1¼ million of pearl-bearing oysters on the beds all the time.

The pearls thus produced have a fine luster, and are marketed in all parts of the world. Of ten pearl-oysters which I was



BOAT-LOAD OF EXPERT DIVERS.

permitted to take at random from one of the planted beds, seven contained merchantable pearls.

A fishery station in the southern part of Shikoku, where I spent several delightful and profitable days, was built two years ago by the local government for the special purpose of developing new methods of fishing and of preserving fishery products. Its working staff consists of a director, eight assistants and thirty fishermen. A noteworthy feature of this station is that it is located on a tract of ground bought by the commercial fishermen

and presented to the government for the purpose. Has anything of this kind ever happened in the United States?

An important business in parts of Japan, more especially in the south and on the shores of the beautiful Inland Sea, is the manufacture of salt from sea water. Many thousand persons are engaged, and the salt thus made is used in the fisheries and for most other purposes, there being very little rock salt employed. The salt fields are on about the same level as the sea, and are intersected by ditches in which the tide flows. The sur-



A FISHERY EXPERIMENT STATION.

face is hard, level and sandy. Water from the ditches is sprinkled by hand over the floor, and then, in order to promote evaporation, men rake the wet sand with a kind of harrow. The sprinkling and stirring of the sand continue until it can take up no more salt; it is then scraped into piles by means of long pieces of wood drawn by the workmen, and put into bins, of which each field has many arranged in long rows. The sand is then thoroughly washed with sea water, and the concentrated brine resulting collects in vats beneath the bins. From the vats

the brine is poured in a sluice or flume and transferred to large reservoirs under cover. As required it is poured on large, shallow sheet-iron trays under which is a hot coal fire, and the water is driven off by boiling.

Events are moving swiftly in Japan. The Japan of a few years ago is not the Japan of today, and the Japan of the near future will not be the Japan of the present. In its fisheries, as in its entire industrial and social life, this land of the Yankees



SALT FIELD, SHORE OF INLAND SEA.

of the east is responding all too quickly to the pace set by the Yankees of the west; and whatever the outcome of the present unfortunate war, the changes in existing conditions will be accelerated. We can not say what developments in the commercial affairs of the nation the present generation or the next may see; but who can doubt that Japan will continue to be our teacher in many things, and that her fisheries and other industries will become even more important at home and to the world at large?

DISCUSSION OF DR. SMITH'S LECTURE.

At the conclusion of the lecture Dr. Smith said, "I shall be glad to answer any questions that you may desire to put to me on this subject."

President Clark: When you are speaking of gold fish do you mean to tell us that they are used for food as well as for ornament?



SALT FIELD, SHORE OF INLAND SEA.

Dr. Smith: They are used exclusively for ornament. It is a common sight, even in the houses of the poorest peasants to find a little goldfish globe suspended from the doorway or the ceiling. (Applause.)

CORSTRUCTION OF PONDS AND POND CULTURAL METHODS.

BY J. L. LEARY.

There has been so much said relative to the construction of ponds and pond cultural methods that it seems but very little additional can be written or suggested along this line that will prove of value to the practical fish culturist, yet those of us who have built ponds have discovered mistakes made in construction as well as experience has shown errors in cultural methods and the room for improvement therein.

The first great essential to successful pond building is abundance of water. I am safe in making the assertion that few pond building ventures have been made that were entirely satisfactory in this respect. We felt confident the supply of water was ample for all needs only to find after our ponds were constructed, nine times out of ten, that this necessary element of success was inadequate to supply the demand.

The course of supply in most cases does not matter so that it is abundant. It may be spring, artesian, taken from some stream, or stored from rain and snow fall. All will answer though of course the purer and clearer the water the better as it adds materially to pleasure and success with the work, but bear in mind it is water—water—just twice as much as you think you need.

As to pond site it is necessarily secondary to water and must be located as near the supply as possible to avoid the expense of long conduits, ditches, or flumes. Where artesian wells are the source of supply and so located that heavy rain storms do not affect them it does away with long flumes or conduits that otherwise must be used to prevent disaster by flooding the ponds and consequent loss of fish. Most of the eligible pond sites are subjected to this danger of overflow and every precaution should be taken to guard against danger from this source. The most secure place is the center of some low flat, or swamp is not objectionable, with the supply of water from spring or spring branch. I would build my pond or ponds in the center of flat

or swamp, making them narrow enough to leave wide spaces on either side, with banks not less than eight feet on top and thirty-five feet wide at base. There is one precaution often neglected in building bonds and that is the foundation or bed for your banks. Be sure that all grass, weeds, and roots are removed and that the earth is well broken as this allows the dirt of the banks to assimilate with the foundation, leaving no seam for seepage which is a source of annoyance and often develops into a dangerous leak. At the level of water held in ponds I would construct drainways to take off the surplus water of heavy rain storms. A good plan is to closely observe during heavy rains the amount of water that flows over the intended pond site and by this means you can calculate very closely the amount of water it will be necessary to divert. Extended flats or swampy places have great advantages for pond building. One is nearly always assured of an abundant supply of water and such a site is less liable to danger from overflows than the narrow gorge of the hillside. Then, too, on such a site you are nearly always assured of an abundant growth of aquatic plants which adds much to the value of the ponds. Where artesian water can be relied upon you can build on the most convenient or desirable location.

Where it is desired to supply ponds with water by diverting part of a stream, although an abundance of water may be assured at all times, it is too often the most dangerous of all locations, as well as the most expensive. Such ponds are more liable to disaster from overflow than other locations. Either you have an expensive dam to build in order to divert the water or it is necessary to tap the stream, if a flowing one, some distance above your pond site and carry the water through a ditch or raceway, and as most streams are liable to get out of their banks at times this proves a source of danger.

The shape of a pond may conform to its situation, making it wide in one place, narrow in another, with symmetrical curves that add much to its beauty without impairing its usefulness.

As to the bottoms nothing uniform is desirable—shallows here and there with little islands covered with aquatic plants also add to the attractiveness and as these shallows may be covered with sand and gravel they make ideal spawning grounds for the fish. If the ponds are for commercial purposes or the

rearing of great numbers of young fish is desired these irregularities should all drain to the draw-off which may be by natural drainage or if so situated that this is not feasible can be pumped out with a small gasoline pumping plant, that being about the cheapest power used.

This emptying of ponds is only needed for pond cultural work. Should the writer ever build more ponds he will have them of not less than one acre each, with irregular bottoms and long sloping inside banks, the bottoms not so irregular as to interfere with seining but having many shoal places for spawning grounds as well as basking and feeding places for the young fish. While ponds built on the above lines are well adapted to all fresh water fish they would be ideal for black bass, crappie, strawberry bass, and in fact all of the sunfish family.

Various methods are suggested and practiced by fish culturists, each no doubt thinking his own plan the best.

While good ponds with an abundance of water are the first needs yet the importance of choice brood fish cannot be over estimated. The mistake that many fish culturists make is over stocking the pond and this should be carefully guarded against. This may vary with climate but taking one acre as a pond basis thirty pairs of fair sized black bass, two and one half to three pounds each, and fifty pairs might not be an extreme. One hundred pairs of the following fish: Crappie, rock bass, strawberry bass, and twenty pairs of channel catfish or carp.

If the output is for commercial purposes some fifteen or twenty nursery ponds or pools will be needed. These should be eight by twenty by two feet deep, with concrete sides and bottoms. The drainage should be perfect allowing them to be cleaned at all times. The water supplying these ponds should be carried by piping and each pool provided with a separate inlet and outlet. The result of various experiments made with black bass shows that no young should be transferred to nursery pools under three-fourths to one inch long as they can then take small particles of food prepared or collected for them. Should the brood ponds be well supplied with natural food the young fish should remain until they can readily take prepared food and small minnows. The best food for most fish is the flesh of fish and the best being the flesh of crawfish, in fact the flesh of any fish so that it is fresh.

My method of preparation is as follows: A white pine chopping block two inches thick as large as desired, a sharp butcher knife, a piece of metal sheet steel with perforations 1-32 of an inch and a glass or porcelain bowl are the articles required for the work. The tails of the crawfish are skinned and the flesh of the other fish skinned and boned, then chopped with the knife upon the board, keeping knife and board wet it can be chopped very fine and screened through the metal sheet into the bowl and thinned to the consistency of cream with water. This is fed to the young fish once a day or oftener if necessary.

The method of transferring young fish from brood ponds I described at some length at our meeting last year.

A PLAN FOR BASS PONDS.

BY E. M. LAMBERT.

I beg to submit herewith a plan for bass ponds which combines the advantage of a large pond for breeding and small ponds to facilitate drawing and cleaning, together with a greater depth of water over the entire pond than is possible in a large pond built on the plan at present followed in this Bureau. The material used in the construction of the subdivisions and outside walls, shown in the accompanying drawing, is wood—concrete, brick or stone can be used instead. The outside walls are built eighteen inches to twenty-four inches higher than the subdivisions, so that when it is desired to convert the four small ponds into one large one, eighteen inches to twenty-four inches of dam boards are inserted in the four outlets and the water rises over the sub-divisions.

Each pond is supplied with a separate inlet and outlet, so that when the water is dropped to the low level a circulation can be maintained as desired. By this arrangement the pond can be drawn down in installments, a great advantage when distribution time arrives. Frequently at the Wytheville station we have found it necessary to draw our largest pond, over two acres, in order to procure 500 or 600 bass to make up a car load. This requires several days, when the pond is full of plant, and a consequent loss of fish, especially in the months of August and September when the water is warm, on account of the fact that in drawing a large pond a long stretch of water line is constantly receding and leaving the fish high and dry, necessitating a large number of men to keep them picked up. Your troubles are not over then, as storage room must be provided for the surplus fish, where they will have food and the required temperature of water until needed for future shipments.

With the subdivided pond the water can be brought to the low level in the series and each sub-division drawn as needed.

Removing plants from a large pond is a very slow undertaking, it cannot be wheeled out on barrows, or hauled on wagon, on account of the soft bottom. This labor is considerably eliminated

entire length of the series, cutting off the nesting grounds so that the large fish are confined to a limited area. One end of the picket is driven into the mud, the other rising to a level of, or a foot above, the outside walls. Gates wide enough to pass a wheelbarrow are set in over each sub-division.

Any size or shape pond can be subdivided in this manner, and can then be used as one large or as a series of small ponds.

Discussion of the papers of Mr. Leary and Mr. Lambert.

Mr. Titcomb: (Before reading Mr. Lambert's paper) I recently visited the Wytheville station, and while talking with a fish culturist there he presented a new idea on the construction of ponds for the propagation of bass, and I requested him to make a drawing and some specifications. Now this paper he did not send for the use of the society, but it seemed to me an idea which possibly might be worked out and become of value to us, and I have therefore taken the liberty to present it at this time.

(At the conclusion of the paper). I have here the drawing which he has made to give the idea. It can be modified in many ways, but as you have learned from the paper, the chief idea is to have a series of small ponds which can be overflowed, and when overflowed form one large pond, drawing down that pond you reduce your fish into as many small ponds as you have partitions, and can take them out at your leisure.

Mr. Leary: I think the plan is quite elaborate, for as soon as you draw your ponds, the fish all go to the upper ends anyway and you can get most of them by seining. Bass do not follow the water, they work against it. So I do not think there would really be any advantage in these partitions, although there might be. But all fish travel against the current, and the minute you commence to draw a pond all your fish seek the way the water is coming from and go against it, and your fish go to the upper end of your pond, so that you would have to resort to seining. Anyway you can seine as many as you want and leave the balance. All stations should have good nursery ponds. And if you cannot use all your fish at once, you can hold them over two or three weeks. That is the way I do—still the plan offers some advantages under certain circumstances.

Mr. Titcomb: You can have a supply in each one of those small ponds.

Q. You can have extra inlets to each of the small ponds?

A. You can have as many inlets as necessary, and supply each small pond separately. You reduce your large pond to a series of nursery ponds, practically.

Mr. Stranahan: This plan would not be at all feasible with us. We can always get out all the fish we want to make a shipment. We made extensive and quite expensive experiments in fencing off, using chicken wire, to separate our adults from our fry, and it was an abject and complete failure, and resulted in the breaking up of our schools. The parent bass would come along the fence with his brood, a portion would get through and get separated, and schools were broken up long before they ought to be, and we had just to remove the fence. It resulted in the loss of a good many thousand fry for us two years ago, and we abandoned the idea, entirely.

Mr. Lydell: I would like to ask Mr. Leary why he needs so much water. Is it on account of its being so warm in your locality?

Mr. Leary: The temperature gets very high, and we have to keep up a fair standard of fullness. We have nine months of summer.

Mr. Stranahan: Nearer twelve.

President Clark: I would like to say a word or two, because our experience this year has not been the same as Mr. Leary's. You remember a year ago at the Woods Hole meeting, I told you that I was an infant in bass culture, and I think I am about in the second grade in the school—and I find that what experience we have had has been a little different from that of Messrs. Leary, Lydell, and Bower. I do not find that bass run up the current at all. They go down in the kettle especially small-mouth bass.

Mr. Leary: I referred to the large-mouth bass.

President Clark: I do not see any reason why we should

have ponds like those referred to by Mr. Titecomb, because in the large ponds they all go down in the kettle as you draw the pond down, and no fish become stranded on the sides. We did not have any such experience this year as has been described. The water was very muddy, and still they went down with the water.

Mr. Leary: I remarked that they will go against the current until they find that they will get stranded and then they take the back current. I never draw a pond until October, but the fish naturally go towards the inlet until they find that they will become stranded, and then they work backwards, and we get all of our last fish when we draw the ponds, right at the draw.

President Clark: In speaking of water for bass ponds, like Mr. Lydell, I do not see why it is necessary to have a larger amount of water for bass; we can give them any quantity desired; but we shut the water down to the lowest limit and still give them water; and I find that it works better that way than any other, and I think the fish will increase faster.

Mr. Leary: You mean you do not have a great overflow to your ponds.

President Clark: That is true.

Mr. Leary: Neither do we; and during the spawning season it is better to cut it entirely out. I think you misunderstood that part of my paper.

President Clark: You mentioned the large supply of water.

Mr. Leary: But we need a large supply for we have nine months of summer. With the evaporation and absorption we have nothing but earth bottoms and banks to our ponds, and my bass are different from yours. Like Texas steers they want a lot of water and room.

Mr. Clark: Mr. Leary speaks of the nursery ponds and placing his fish therein and keeping them one, two, three, and four weeks, or any number of weeks. He must have to supply artificial food at that time.

Mr. Leary: Yes. I did not say that was necessary—I say if you have fish left over from shipment, put them in your nursery pools and keep them. We have in the upper part of the river where I am located, a very large supply of minnows this year.

Mr. Clark: But with the younger fish would you not keep them in the larger pond and distribute them from these if you had plenty of food, in preference to taking them out and placing them in nursery ponds?

Mr. Leary: Yes. I said if you had abundance of food in your ponds let them stay longer. It is only when your ponds are exhausted of food that you should take them out.

President Clark: Speaking only of the large fish?

Mr. Leary: No, the small fish too—never take fry or very small fish from their natural conditions; if you do a loss will follow.

Mr. Stranahan: After three years of careful experimenting we have concluded it was a bad practice to move small fry like that (indicating fry from three-fourths to an inch in length) to fry ponds unless we are going to move them from the ponds within two or three days. If the male fish has abandoned the brood and it has become broken up into half a dozen little schools, they will become scattered around over the pond; and if we are not going to make shipments for two or three days, we take the little fellows out and put them in a small pond; but if they are going to be held a week or so, with all the feeding we can do we cannot succeed in saving very many of them. We will lose ninety per cent a week, if they are an inch long.

Mr. Lydell: I am afraid that we are going to get mixed up. These gentlemen from the south are talking about large-mouth bass and you and I are speaking of small-mouth bass. We move our small-mouth bass to a nursery pond as soon as they rise up from the bed and commence to take food. They claim they cannot do that and do it successfully, but they are speaking of the large-mouth variety. The large-mouth bass that I have had experience with this year we moved to our nursery

ponds when about one and one-fourth inches long. I did not see that that hurt them a particle, although we would not take them smaller. But they are talking of large-mouth bass and we of small-mouth bass and we are liable to get confused.

You said, Mr. President, that you were in the second stage in progress in bass culture. I think the whole of us are about in the baby fingerling stage in bass culture, and I think we will have a lot of hard work to do before we get up to the yearling stage.

Dr. Johnson: There is a simple question perhaps which has puzzled me, which is an important factor, and that is the care of the wire. What has been found to be the best coating to put on your wire? All wires will rust, and as soon as they get rusted they hold debris. I have found fish commissioners of different states suggesting different things. I would like to know from authorities if there is any one particular thing that can be put on to the wires that will preserve their integrity. In my own very small pond on each gateway I have very fine wires, as I am dealing with small fish; and I protected that wire to a certain extent by making a V out in front of it, with large mesh wire, and using a small platform which gave me a place to stand on, and from which casting is more easy, and the wire being strong in the winter when the ice comes it is pushed to one side. There is a thick oil, a petroleum product, that works fairly well, until it gets rubbed off. Further, an expensive way of getting over the difficulty is to have double sets of screens and when one gets very dirty put in a fresh one; but there ought to be something to coat the wires with, and that problem enters into every pond where you have any screening.

Mr. Leary: We screen all of our outlets with perforated zinc sheets.

Dr. Johnson: Suppose you use wire, what would you coat it with?

Mr. Leary: I have never found any wire that would stand except galvanized wire.

Dr. Johnson: That I have used.

Mr. Leary: That don't stand in our climate. We have heavy limestone water with magnesia and iron and nothing can be used as a coating that will last, but for our outlets we use perforated zinc sheets exclusively.

Mr. Stranahan: We believe the cheapest course is to use brass or copper wire entirely. We have never found anything that we can coat with that will not come off.

Mr. Dean: Why use wire instead of zinc?

Mr. Stranahan: Well, it was on hand partly when I went there—secondly because it gives a little bit more surface, but we do not need much wire. We calculate to cut our water down so that we won't have much overflow at any season of the year.

Mr. Dean: The great thing in favor of zinc is that it cleans easier than wire.

Mr. Leary: It does.

Mr. Dean: And won't clog up so quickly, and if you coat perforated zinc with turpentine asphalt it will withstand the action of almost any water, although there are minerals that will eat it. There is something in the water at our place that will eat it out after a while, but a zinc screen will last on an average of two years in our waters.

Mr. Lydell: I have found in my experience that the best wire preservative is asphaltum and tar, half and half, and put it onto your wire when it is at the boiling point. It will preserve your wire for several years and will become very hard and after being applied and dried it is very hard to get off from the wire.

Mr. N. R. Buller: I have found that pure coal tar with proper proportions of red lead and white litharge and turpentine put on boiling hot is the best covering. It is not easily rubbed off and lasts two or three years.

Mr. Dean: The Harrington King Perforating Company of Chicago have a bronze metal they claim is practically everlasting in almost any weather.

President Clark: We use ordinary galvanized wire for our

ponds, coated with asphaltum. It is put on when necessary to renew. It will last from one and one-half to three years, and this wire as you know costs from five to seven cents a square foot. I think if it was used it would be found the cheapest and best. Zinc costs a great deal more and the galvanized wire answers the purpose.

Mr. N. R. Buller: I use the galvanized wire altogether, but I think with the addition of red lead and white litharge to the plain asphaltum it becomes harder than it does in its natural state and will last a year or two longer than if we use the pure asphaltum as a coating.

SOME NOTES IN CONNECTION WITH THE BASS WORK AT MILL CREEK STATION.

BY DWIGHT LYDELL.

The output of bass from the Mill Creek Station and auxiliary ponds during the season now practically closed, was as follows: Small mouth fry, 82,000; small mouth baby fingerlings and fingerlings, 24,000; large mouth advanced fry, 452,000; large mouth baby fingerlings and fingerlings, 88,500, all as per sizes herewith shown.

As the subject of propagating bass was pretty well threshed over at our last two meetings, there is perhaps little to add at this time, at least in my own experience, that is new, but I invite your attention to one or two points that may be of interest and value. First, in regard to the construction of spawning boxes and the setting of the same, for small mouth bass. Two years ago, at the Put-in-Bay meeting, I recommended a box enclosed or protected on three sides, leaving only one side open for the entrance of the spawners. In practice, however, I find that the three-sided box is too restricted and that it is much better to have two sides open than one, to allow more room and greater freedom for the circling and maneuvering of the spawning pair. By experiment I also found that a single row of beds placed twenty feet apart around a pond will turn out more fry than a double row with twice as many breeding fish, and the reason is apparent. In single rows there is little or no occasion or necessity for the fish to pass close to one bed in order to reach another, hence there is much less jealousy, friction and scraping.

That the male small mouth bass will mate twice in a season and take care of two successive broods of fry, was demonstrated beyond doubt at Mill Creek this season. Twenty nests, twenty males and twenty-eight females were placed in pond number three. On May 4th fourteen beds were spawned on, of which thirteen were productive. May 27th, twenty-three days after spawning, the fry were removed and shipped or transferred to rearing ponds. On May 29th, nine of the beds from which the

first hatchings had been taken two days before, were reoccupied and spawned upon. All of these nests proved productive though the average per nest was smaller than the first crop. Owing to warmer weather and water, the fry from the second spawning were ready for the screens June 6th, or only eight days after the eggs were laid. Here, then, were twenty-three nests of eggs in the two crops, all productive but one, and only twenty male and twenty-eight female bass in the pond; so that at least three males must have mated a second time, while, apparently five females did not spawn at all.

In regard to the shipping stage for young bass, I think that they should not be sent out as fry, that is, at the swimming up point. The large-mouth fry are extremely small and helpless at first, and while the small-mouth fry are much larger, the instinct of fear is undeveloped, and this, in connection with their color, a jet black, makes them a conspicuous and easy prey for their enemies. They should be held at least until they have assumed the color and form of mature fish, a period of ten days to three weeks in our locality. Beyond this point, however, there is danger of losses by cannibalism, increasing as the disparity in rate of growth becomes more marked. We recently had this experience at Mill Creek, in a pond of small-mouths held until forty to sixty days old. Fingerlings were opened and found to contain two or three undigested bass of about half-fingerling size, while one greedy fellow was actually seen to seize his own tail and swallow himself. It is evident that the young in rearing ponds should be thinned out and shipments commenced as soon as they are one and one-half inches in length; otherwise the increasing demand for food soon overreaches the food-producing capacity of the pond. I believe that it is not profitable to hold them very long after there is much variation in size, at least until we have learned how to provide their natural food, or a substitute, in sufficient volume for their needs. This season we discovered that there was a great deal of food in the ponds, suitable for fingerlings, that was made available only when the vegetation was raked up and washed out. By stirring up the bottom and raking out the chara and other vegetation and rinsing it off, a surprising quantity of food, chiefly very small shrimp, was driven from cover—"flushed" so to speak, for the

benefit of the hungry little bass. And the bass soon learned what it all meant, congregating in schools whenever and wherever the rake was set in motion, much the same as a lot of chickens come running from every direction at a familiar call that means, "dinner is ready."

A word as to food for the adult or stock bass. We have found that liver in the summer and minnows in the fall and spring answer the purpose very well and keep the fish in good condition. Recently I have found that blood makes excellent food for bass, although of course we have not fed it to any extent, owing to scarcity of the raw material in my locality. To one quart of blood, fresh and warm from the animal, I add two rennet tablets (known as "Junket" tablets,) previously dissolved in water. The blood soon coagulates or curdles, changing to a mass about the consistency of gelatine or thick jelly, which may be cut into strips or cubes just the same as liver. The bass take it with great relish, and if any falls to the bottom and not picked up, it soon dissolves or disappears, leaving no foul matter in the pond. I don't know whether this method of preparing blood for fish food is new to others or not, but it is new to me, and was suggested on witnessing the action of rennet in converting warm milk into curd.

Considerable has been said in the past about handling adult bass in the spring, with reference to the effect of handling and transportation on spawning and hatching results. So far as large-mouth bass are concerned, our experience is that it makes little or no difference what time the stock fish are caught and brought in from outside waters. During the season just past we took a number of adult large-mouths from the Saginaw river that were nearly ready to spawn, transported them to Mill Creek, a distance of about one hundred and forty miles, and secured excellent hatching results. Some of these fish spawned the third day after arrival and produced a fine lot of fry. This suggests the possibility of artificial propagation, and right here I wish to inquire if anyone has tried to strip and fertilize the eggs of large-mouth bass.

But what has been said on this point about the large-mouth bass does not apply at all to small-mouths. Our recent experience in transferring the latter from outside waters to the station

ponds only confirms what has been stated before, namely, that the fish must be caught and placed in the ponds in the fall and not in the spring. A year ago last spring we were a little short of small-mouth breeders, so we took fifty adults from an inland lake and transferred them to a pond at Mill Creek. These fish did not mate nor show any indications of doing so, and not one of them spawned. Late in August I opened some of the females and found that most of the current crop of eggs had been cast and that the eggs remaining were very soft and apparently ready to slough away. Eggs for this season's spawning were also in sight. The influence of a suspension of the spawning function through transporting in the spring, appears also to reach forward to the next season, for this same pond had only six productive beds during the season just closed. Involved in the propagation of small-mouth bass are many perplexities and uncertainties, but if there is any one feature concerning which a definite rule may be laid down, it is that the adults must be brought to their spawning quarters seven or eight months in advance of the spawning season; this gives them time to become familiar with their surroundings and to get acquainted with each other before it is time to select their mates, build their nests, do their courting, get married and settle down to the business of multiplying and replenishing the waters. But if for any reason the union proves unfruitful, as is too often the case, and there is a tendency towards "race suicide," then is your resourceful man in charge ever ready with a convincing bunch of theories explaining it all and pointing out exactly what he proposes to do "*next season.*" On the other hand, if the bass haven't spawned on Friday or the 13th of the month, and no one about the place has seen the new moon over his left shoulder, in short if all hoodoos have been sidetracked and the angel of good luck hovers gently o'er the scene, impelling the parent stock to cover themselves with glory and their nests with a goodly bunch of fertile germs, then may the superintendent of a station smile serenely, throw a large and fragrant bouquet at himself, look wise and say, "I DONE IT."

(Preliminary to reading of Mr. Lydell's paper.)

Mr. Seymour Bower: I wish to say that Mr. Lydell does not claim that this short article rises to the dignity of a formal paper. It is merely a few scattering notes hastily thrown together at the eleventh hour and fifty-ninth minute.

(Speaking, after reading first paragraph.)

The Michigan Fish Commission has recently established a new bass station at Drayton Plains. It is not at present very far advanced towards completion, but from this station we distributed this season about 165,000 advanced fry and fingerlings, mostly large-mouth, in addition to the output from Mill Creek. And right here I desire to explain how we grade our fish, what we mean by fry, fingerlings, etc.

A. By fry we mean fish that have just risen from the bed; that is, they have risen up so that they are going to remain up, and have not taken any food, or practically none.

B. By advanced fry we mean fish three-fourth to one and one-fourth inches in length regardless of age.

C. By baby fingerlings we mean fish one and one-fourth to two inches in length, also regardless of age.

D. By fingerlings we mean fish two inches long up to whatever size they may attain at the end of the shipping season.

(At the conclusion of the paper.) In this connection I want to call attention to one or two bottles of specimens that we brought here. You will probably all look at them before we adjourn.

Here is a bottle of fish that I wish you would all look at, because they are all of an age—we know that—we drew the pond this spring and prepared it for a nursery pond, and no fish were put in there, adult or small, except 50,000 small-mouthed fry. At the age of sixty-five days these specimens, representing extremes, show the disparity in growth. Some specimens will weigh fifty times as much as others of exactly the same age! Of course that pond was overstocked, undoubtedly, but it shows what a great difference there is in the growth.

Mr. Lydell: I do not think it is overstocked now. (Laughter.)

Mr. Bower: Here is another specimen of small-mouth bass with a large-mouth bass recently removed from its stomach.

Here is another bottle containing a large-mouth bass that had just recently swallowed another bass. The stomach is distended and distorted.

Mr. Jordan in some of his writings has quite a good deal to say about the voracity of Pacific salmon, and indeed they are wonderful feeders and growers; but I think that in the earlier stages at least they are not in the same class with large-mouth bass, or even with the small-mouth bass. He says that a salmon never eats except when it is hungry, which is all the time, and then it eats a little between meals for its stomach's sake. (Laughter.) To show the difference in growth I exhibit to you a specimen of Pacific salmon fifty days old, and you can compare this specimen with bass of the same age and find the former to be very much smaller. I do not think there is a fish that swims that is so avaricious as the bass in its earliest stages. In fact, if I were asked by anyone to suggest a design for a combination of greed, voracity and gluttony I would call attention to the bass as being the best emblem of that combination possible to be obtained.

Dr. Johnson: I do not want to do all the talking but I want to learn a little bit more, for I came down here rather as a student than a teacher. This question about preparation of blood is interesting, but why is it necessary to add rennet to blood? Is it to make it more digestible, or to make a stronger coagulum only?

There is one little point in these so-called artificial foods that rather surprises me, which has not been touched upon at all, in the preparation. It would seem to me that the addition of ordinary salt would be beneficial in a great many ways. Now we know that trouts are very fond of anything that is salt. I have proven that simply by trying to get the best of a fish hóg that I once ran into who each and every day always selected a certain pool and would not let me fish in it. I did not want many of his fish, but I wanted his room, and his disappearance once in a

while, and I did want to cast my flies into that one particular pool. I would not ask him for it, but I took my canoe and anchored it quite a little distance above him, but I did not anchor it with a stone. I anchored it with a bag of rock salt, and as soon as the salt began to dissolve I made my cast around my canoe, and the fish all left the pool and followed the salt up; so I got the best of that one particular fish hog that I was fighting, and it showed me clearly that fish love salt. Another thing they love is sugar, and both of those things are good for a trout. When a trout does not rise well to the fly, if you are whipping a pool (this I am afraid is talking the sportsman, still it might give a hint as to the feeding, etc.), you take vaseline that you have mixed sugar with, and smear your fly with it, and it will leave a trail on the water which will often attract a big fish. He will follow up the sweet place and take the fly, as he thinks it is a sugar plum. We all know a trout will run into salt water for food. I believe that the salvelinus runs down out of his fresh water bogs into the sea and remains there because he gets more food, and returns every year to his home. He soon gets acclimatized to the brackish water with a certain amount of salt in it. We are apt to forget the essential thing, it seems to me, in feeding fish, as we do in feeding human beings. I have always claimed (and pardon me for talking medicine just a moment) that we made our mistakes as physicians in this world too often—very much too often—by doing one thing or the other as far as diet is concerned. We concentrate the diet list down to monotony or we push our poor patients into some devilish theory which eliminates lots of good food that they ought to be taking. More patients have been killed in diabetes alone by putting them on a rigid diet list, than by giving them plenty to eat and drink. My patients get better under a broader diet list. So we choke down our fishes, never thinking what they want and need; we give them a monotony of food, and that monotony in itself, I believe, brings about deleterious changes both as far as their flavor and taste go, and as far as diseases go.

Now we have left out one thing that is necessary to digestion. All fish have pepsin enough, all fish have good strong gastric juices, strong enough to digest the living animal. Take two frogs for instance, poke the leg of one frog into the other chap's

stomach, and he will digest the webbing, and even the bones of the living frog. That shows that the gastric juice is strong enough. Now if we can incorporate salt into food, liver or what not, we will make that very food much more digestible, consequently much more easily assimilated, and will eradicate utterly certain bad effects that would come from giving the food alone; and I should say that you can get a coagulum out of fresh blood quickly enough so that it will be held together, and that it would be better to add salt, in my opinion, in moderation, than it would be to add a peptonoid.

Dr. Henshall: I think salt is pretty generally used by fish culturists. I put considerable salt in liver when ground, and in addition to that I salt all my ponds once a week.

Mr. Lydell: I wish to say that the use of this rennet was especially to hold the ^(liver) liver together in a solid mass so that you could cut it into strips. Taking it cold and cutting it into strips it will break up and the bass won't take it; but by making it solid I cut it up into strips two or three inches long and a quarter of an inch thick, and it can be stretched like rubber, and it won't break, and the bass take it readily; but take a square or round piece of blood and throw it out to the bass and they won't take it. The bass want something that will start to move, like a worm, when it sinks, and that is the only reason we use this rennet.

Mr. Seymour Bower: In our trout hatchery at Paris we use food at the present time in which there are a good many different elements. It is composed of shorts, corn meal, Bowker's animal meal, and a definite proportion of salt.

We feed it all summer to our adult trout, alternating this food with liver. It is known as Lane's food. Mr. Lane can tell you all about it.

Mr. Lane: Mr. Bower has given you the receipt. He has perhaps not given you the exact way of making it, but it was given at this meeting two different years, and you will find it in the last reports. We use a certain amount of salt, which has proven to be beneficial to trout. I do not know as I have anything new to say on this question.

President Clark: While I hate to prolong the discussion, I want to say a word or two on the bass question, because there are some things that our old bass culturists like Mr. Stranahan and Mr. Lydell have not touched upon at all. We have only had this one year's experience with bass, and small-mouth at that. I have some notes on the matter but nothing in the form of a paper, and I will just refer to them occasionally.

We placed twenty-eight pairs of adult bass in our ponds, and from these we succeeded in finding eighteen nests, out of which thirteen produced fish. We did not find the eggs and the nest until after we went over to the station of the Michigan Fish Commission and examined the beds there, then we came back and found the eggs—we did not find them before—whether they spawned during those eight or ten hours while we were gone or not I could not say. Possibly we did not know what to look for exactly. However they hatched out and we screened the fish at the proper time when they came up from the bottom of the nest, and we took some of the young bass out of the nest and placed them in another pond. Previous to the spawning, however, we had sorted the bass, as Mr. Lydell says, and placed in one pond these twenty-eight pairs, as we supposed, and took a surplus of seven males, as we supposed, and placed them in another pond. In that pond we counted and placed 8,500 fry of a certain size and took 9,700 out—I do not think any of you can beat that. (Applause.) The only way I can account for it is that the seven supposedly male bass were not all males. However, when we drew the pond down there was no indication whatever of any old nests. We took 9,700 out and the fish culturist estimated there were still 2,000 to 4,000 left in the pond. After we reached that point I told him the experiment was ended.

Another thing that has not been touched upon by the bass culturists is the movement of the fry and baby fingerlings. We had an experience this year that I have never heard anybody touch upon. After the screens were lifted and we let the balance of the fry go, in perhaps twenty-four to thirty-six hours, the bulk of those little black fry were all around the edge of the pond. This pond is about 175 by 200 feet. They stayed there until about forty days old and grew very rapidly.

We have a growth here in the specimens presented, of five-

eights of an inch in only four days, from the 27th to the 31st days. And these fish were not sorted out but just simply taken as they came, in a small seine.

Now, after about this size (indicating fish forty days old) these fish disappeared from the edges of the pond and were practically gone. Once in a while you would find a stray fish, but the bulk of them had gone out to deep water. They were growing very rapidly. They came back in a certain number of days, which my notes here will give—I think about six or seven days—to the edge of the pond, and we found these fish, forty-six days old—you can see them readily (indicating specimens). There may be some in the middle of the pond—I don't know how that is. Now as nearly as we could find out, in hunting for food, these fish went from the edge of the pond into deeper water—either following food or after another kind of food—and they probably found that food, and at this size (indicating) they came back to the edge of the pond. What for? For food, because here we find some ten days older and there is practically no difference in the size. That is my theory of it gentlemen.

Therefore I have come to the conclusion that bass should be distributed at the earliest age possible, as baby fingerlings. They have grown rapidly up to this time and are still growing; but when they came back to find this other food, it is not in the pond, and they then begin eating each other up, therefore I think this is the proper age to distribute the small-mouth bass, when they are baby fingerlings, or fingerlings, if you please. I think when small-mouth bass are that size, they will take care of themselves as well as if larger. That has been our experience this year. From the twenty-eight nests thirteen were productive, from these we distributed 15,000 or 20,000 fry, and we still have fish in the ponds, but they are gradually growing less and less. I do not expect to take 1,000 fish out of these ponds when it comes fall. I think with the present arrangement of our ponds we will be able to turn out half a million fingerling bass, but I do not think it advisable to hold them unless you have an immense pond area. Nothing that you can have at any ordinary station will warrant holding the fish, for the food is not there in quantities and the fish will eat each other up; but for the younger stages we have an abundance of food, and I think you will find it true in almost

all cases, that the time to ship bass is in the baby fingerling or fingerling stage.

President Clark produced seven bottles of small-mouth bass as follows:

1. Northville station, small-mouth bass, ten days old, June 7, 1904, specimens about half inch long.
2. Same twenty-one days old, June 18, 1904, an inch long.
3. Same twenty-seven days old, June 24, 1904, one and one-half inch long.
4. Thirty-one days old, June 28, 1904, about one and three-fourths inches long.
5. Forty days old, July 7, 1904, about two inches long.
6. Forty-six days old, July 12, 1904, about two and one-fourth inches long.
7. Fifty-six days old, July 22, 1904, about two and one-half inches long.

Mr. Brown: I want to ask if you have any idea after you have distributed the fish to the citizens how many of the fish have been taken out in the middle of the lake and deposited and consequently your work nullified; or what has been done to educate the people as to the proper place to put the fish? I have personally seen so much ignorance displayed in the disposition of trout and bass that have been delivered to people for distribution, that I have sometimes felt almost discouraged. I think there ought to be concerted action used in furnishing information, both by circulars and papers, as to where the bass should be placed.

Mr. Seymour Bower: As far as our commission is concerned it is not our fault if the fish are not placed in the proper places. We send out a notification in advance, advising date of delivery, with full directions where to place them, and we have a label on the top of each can that repeats the same directions. We cannot control the fish after they leave our hands, and no doubt in some cases the fish are wasted, but I think that the great majority of

applicants who take the trouble and pains to drive to the streams, and who like to fish pretty well themselves are therefore interested in getting the best results, will follow the instructions we give them. Of course it would be an excellent idea if all the sportsmen's papers would publish that information once a year, and it would help a great deal, no doubt.

Mr. Lydell: I am afraid Mr. Bower did not carry that suggestion far enough. He says he sends them a letter and also directions on the can. In addition to that when the messenger leaves the Mill Creek station he has a folder six inches by eight, in his pocket, folded up three times, and on the back of that in large flaming letters it says, "Directions for planting bass," and when he opens the folder the customer sees that legend; he can see it clear across the room; and one of those is handed to each applicant for bass, by the messenger when he delivers the fish.

Mr. Titcomb: I want to ask one question, and then I want to touch on Mr. Brown's question.

How many bass did you have in that pond that you do not expect to get a thousand out in the fall, and how many are there now?

President: Of course I cannot tell now but when we counted the 8,500 where we took 9,700 out, my estimate on those fish was between 50,000 and 60,000 at least. It is a positive fact that they are certainly eating each other up.

Mr. Titcomb: No doubt of it. I think the question raised by Mr. Brown is important. It has been my experience that it is almost impossible to get these applicants for fish to read any directions when they get the fish; they won't look at the directions on the can. If it was not for the expense, I would advocate having the bureau of fisheries plant its own fish, have the messengers carry them and put them into the waters. Of course we do that with the great proportion of our commercial fishes, but in assigning bass and trout and fish of that character we do not. But the applicants always receive general directions about planting fish in the notice which is sent out with the other particulars after their application has been filed.

President Clark: I received instructions from Mr. Titcomb to hold these fish for fall distribution.

Mr. Lydell: I think in regard to planting those fish the same as you do. About the time they leave the shore and disappear is the time to get them out and plant them. Of those fish that we have there of the various sizes of the same age, there were about 50,000 put into this pond. I think if we had shipped them at the size you recommended we would have shipped 40,000 or 45,000 out of that pond—perhaps more. We did not do it and commenced shipping a couple of weeks later; and we have shipped 10,000 or 12,000 and there are probably 4,000 or 5,000 left in the pond, and I doubt if there will be a thousand of those there this fall. The smallest fish in that vial are a great deal smaller than they were about two weeks ago. One of the employes at the hatcheries wanted to know what was the matter with the fish in pond No. 1. I said, "Nothing." He said, "They are getting smaller." I said, "We have grown them up to fingerling and we are going to grow them back to fry, and start all over again." (Laughter.) I do not think those smallest fish have advanced a particle in a month, and then is when they ought to have been shipped. I think the time to plant these fish is when they are baby fingerling, or fingerling.

Mr. Stranahan: We have found by carefully watching our shipments into Florida, Alabama and Mississippi, in the hands of pretty good men, such as Mr. Cunningham and Mr. Brown who have been directed to observe the results carefully, that we could do the best work and get rid of our fish (and we had to get rid of them or overstock our ponds) by planting that smallest size which you have there, which is about an inch long. We can handle a thousand black bass in a ten-gallon can of that size, and where we have taken them right out and counted an estimated thousand we have found 1,300. You are pretty apt to underestimate such small fish, and my opinion is for the large-mouth bass south, that a size if anything a little smaller than your smallest lot, is the best size to be shipped, because of the large numbers that can be handled and of the great success we have had in handling small fry. We have gone long distances without the use of very much ice.

President Clark: In what we have distributed this year we have only carried 250 to the can, and have been quite successful. We want them in as good condition when they get to their destination as when they start. Three hundred did not work very well. Two hundred and fifty to a ten-gallon can we actually counted.

Mr. Baldwin: How many hours could Mr. Stranahan carry a thousand black bass to the can?

Mr. Stranahan: The black bass that we have usually shipped, as I say, are somewhat smaller than those shipped by Mr. Clark. We carry them three days. Of course that requires the use of a considerable amount of ice. Mr. Brown and Mr. Cunningham both were our messengers this year, and they report that they had better luck with the black bass three-fourths of an inch long, on long trips, than with those that were longer.

Mr. Baldwin: I would like to ask Mr. Clark how far he would carry his 250 to a ten-gallon can successfully.

Mr. Clark: The longest trip was twenty-nine hours from the time the messenger started from the station.

Q. That is the size you call fry?

A. No sir, baby fingerling.

Q. What length?

A. Well, they are an inch and a quarter.

Mr. Baldwin: I do a good deal of that kind of work.

President Clark: They are from twenty-seven to forty days old.

Mr. Baldwin: (To Mr. Stranahan) You put a thousand to a can. Now in those seventy-two hours how many dead fish do you have?

Mr. Stranahan: Practically none.

Q. Do you count your fish when you start out?

A. We count batches.

Mr. Baldwin: I handled 107,000 this year, and took them out, and I think my loss was 200. Every fish is counted out to me before I leave the station, and every fish I lose over five is reported to Washington. You take a thousand fish like those (three-fourths of an inch), I cannot do it without loss in our Texas climate.

Mr. Stranahan: I can only tell you what our messenger's reports say. Mr. Cunningham started to write a paper but did not finish it, on the method of carrying large numbers of fry without loss.

Mr. Baldwin: In Texas waters if you carry fish three to six inches long, fifty to the can, twenty-eight hours, it is impossible to get through successfully. I carry about seven and one-half gallons of water in a can, but the fish that I carry, one hundred to the can, run about two inches or more in length. Of course we have a great many lay-overs there and a great many changes, but I cannot carry a thousand to a can. I have carried as high as thirty-eight cans of fish in one baggage car in Texas sixty-eight hours, and those thirty-eight cans only contained 6,800 fish, and that is why I asked the question.

Then in Texas you cannot change water. I never change the water, do you?

Mr. Stranahan: It is not necessary. We do not want it changed. We use lots of ice.

Mr. Baldwin: I am very much interested in this work and I would like to know if anybody can beat me carrying fish. I want some pointers. Every fish that I carry is counted. You know there is a vast difference between estimating fish and counting them, and every fish that I carry is counted to me by the employes of the San Marcos station, and I get a receipt for them, and I have had men count them on me. They do not always take my word—that is the point I wanted to make—actual count. I wish to add that I am talking about large-mouth bass and assume the gentlemen from the north are talking about small-mouth bass, which might make some difference.

Mr. Stranahan: In all of our small fish we estimate them,

but I believe we over-estimate rather than under-estimate. When they put up ten or fifteen cans with a thousand of those little fish in, they do not know which one of these cans will be taken out and counted. They have been taken out at least once a week and frequently oftener, and counted. I counted a can myself this summer, and there were over 1,300 fish in it. I ordered the men to be careful not to over-estimate, and very seldom do they run under 1,000.

Mr. Seymour Bower: This question of the size of bass seems to resolve itself into whether it is better to plant 50,000 an inch long, or an inch and a half, or 2,000 or 3,000 about two inches long—3,000 or 4,000 perhaps. It seems to me it is better to plant the larger number. When the bass have reached a certain age and average one to two inches in length, they either require a different kind of food, another type of food that the ordinary pond does not furnish, or else they have exhausted the daphnia and small crustacean life they subsist on from the beginning. The ordinary pond does not furnish the larger type of food, hence it is not profitable to carry them longer, as they commence to prey on one another. It is the only food they have.

Mr. Titcomb: This question has been brought up in such a way that perhaps I ought to say what the policy of the bureau of fishery is with reference to the distribution of the black bass. It is necessary to consider it in all its phases. Now, today, we do so, and since the last meeting—in fact before the last meeting—we began distributing the black bass when they were very young, so far as possible. We have these stations scattered over the different parts of the country, and we have applicants still more widely scattered. Some of these applicants can be supplied by sending messengers in baggage cars with cans of fish; others can only be economically supplied by sending the bass along with other species of fish in carload lots for a thousand miles or two thousand miles even. Therefore we cannot set a time or regulate the time of distribution exactly by the size of the fish. If it were possible for the Bureau of Fisheries to distribute the bass from all its stations at the time considered by it most suitable, it would distribute when they are the size mentioned by Mr. Clark. We would begin distributing even when the bass is only ten days

old. They are then fully developed young bass, well able to take care of themselves, and if you begin distributing at that age, you cannot get rid of all your bass before they are twenty or thirty days old, and in the meantime they are eating themselves up. In the Texas station Mr. Leary begins distributing early in the spring and he is distributing fish all summer, but he cannot be regulated by the size; for they grow so fast he cannot get rid of them soon enough. His messengers are taking fish out from the 18th of April on.

Q. What were the size of the bass on the 18th of April?

Mr. Leary: Nearly two inches long—from an inch and a half to two inches.

Q. Could you not begin a little earlier then, advantageously?

A. Yes, I suppose I might.

Q. You could get out more fish.

A. If numbers count for anything I could get out a great many more, but I do not know whether we should have to sacrifice results or not.

Q. Don't you think those small fish in a large body of water are less liable to eat each other up than they are in the small ponds where you have them?

A. There is something in that, but I prefer to plant a larger fish.

President Clark: Why?

Mr. Leary: That has been my experience, and experience teaches us pretty nearly when we are right. All of my plants have given perfect satisfaction, and all the ponds that we have stocked have choice supplies of fish, and I do not believe it would have been so if we had put in fry or very small fish that the sun perch and catfish would catch or could destroy. It is an established fact that every pond contains sun perch and catfish, and without a doubt they would catch those little fellows.

Mr. Titcomb: In connection with the naming of the time for distribution, of course where a station puts out a number of species you have to consider that to some extent. Mr. Clark has been directed to hold one pond of his bass after distributing the others at the size we considered most suitable. The reason for that is, that we have filled all our applications in his territory and have some applications from distant points which we hope to be able to fill from his station, in connection with other distributions in the fall. We hope that there will be enough of those fish left to do this, and we feel that we can afford to sacrifice through cannibalism at least half or even more of the stock he has on hand, provided we can at that time have available a supply of bass to carry to our more distant points.

In discussing how many fish are being carried to a can, I think Mr. Baldwin and Stranahan have not had in mind exactly the size or age of the fish they were carrying; and in pursuing the discussion in connection with Mr. Clark's work we must consider that Mr. Clark's waters are much colder than those of the south, and that he is dealing with the small-mouth bass instead of the large-mouth bass.

Mr. Lydell: I would say in regard to distributing bass we distribute 250 to the can, baby fingerling, from Mill Creek, and have no trouble in carrying them; but they are carried in spring water of about 58 degrees temperature.

In regard to planting those small fish, Mr. Bower instructed me to plant baby fingerling; he said that is was much better to plant 40,000 of them than to plant 10,000 of such a conglomeration of sizes as are shown here.

WHAT I HAVE SEEN OF BLACK BASS.

BY SAMUEL LOVEJOY, OF BULLOCHVILLE, GEORGIA.

Five years ago we began feeding our adult bass with cut mullet. We throw our feed into the pond and the bass take it readily. I have seen taken out of the same pond eleven tubs of pollywogs. I have seen fingerlings swimming within a distance of ten inches of the adults which paid no attention to them; but if we catch a fingerling and throw him back into the pond he will be caught before he strikes the water. The same way with the pollywogs. Therefore to feed adult bass by throwing the feed in the pond to them will stop cannibalism. At the same time if we put new or wild fish in the pond they will catch the fingerlings for a while until they learn to eat from the hand. I have seen some few adults dash into a school of fry. The new ones before they learn to take the food stay around in the shallow water, while the tame ones swim in the deep water where we feed them. I have seen more baby fingerlings taken out of ponds where fingerlings were scattered all over the pond, than where there were no fingerlings. I think that wild adults do more harm in eating fry than fingerlings do. I believe fry of the same school (the overgrown ones) will eat each other. I have seen yearlings swallow fish very near their size when thrown among them as we feed them. Then you can put the same sized minnows in the pond and let them swim up to the bass and they will not pay any attention to them. I think that it is caused by feeding from the hand. I believe that feeding from the hand by throwing the food into the pond will go a long ways towards stopping cannibalism.

DISCUSSION.

Mr. Stranahan: This paper is by one of my assistants, a colored man.

Mr. Lydell: I have had no experience in feeding fry, but I have had experience in the feeding of adults. You take the seine and seine the minnows out of the pond, go up on the bank, throw them out into the pond, and they are readily taken.

Whether it is due to lack of swiftness in pursuing the minnows or not, I do not know, but there are worlds of minnows in the pond, but the larger fish do not get them.

President: Do you kill the minnows?

Mr. Lydell: Yes, or feed them alive. Probably they could not catch them when they were in the pond naturally.

Mr. Stranahan: I would say to brother Lydell that I do not think that it is the only reason, because they cannot catch minnows, for the reason that we propagate tadpoles in enormous quantities, taking sometimes out of an acre pond seven or eight washtubs full of tadpoles in the fall when we draw the pond down; and it is one of our main sources of food supply. You can see the tadpoles numerous among the bass, which pay no attention to them, but seine out a pailful and throw them in and the bass will take them until their bellies are absolutely distended.

I believe Mr. Lovejoy is correct in many of his observations. Abundant feeding is the best means of preventing cannibalism: then later when that danger is over, cut the feeding down.

Mr. Lydell: We have worlds of tadpoles in Mill Creek, but not with the adult bass. We get probably half a pailful of large sized tadpoles in a seining. I think they are young tadpoles from last year, but we do not find any where our adult fish are, but they are all in where our fry are. The adults seem to have cleaned them all up.

Mr. Titcomb: I think the point of feeding during the breeding season is one to be considered, and I would suggest that those superintendents who advocate the partitioning off of the breeding bass, the brood stock, from the rest of the pond, try both methods. At the Fish Lakes station where Mr. Green is superintendent, we have taken away some of the partitions and allowed the large mouthed black bass to make nests wherever they please. All of the adult fish are fed every day, and we find that the adult bass do very little feeding upon the young; cannibalism is confined almost entirely to the young fish. Seining of these ponds is begun when the fish are at the youngest stage shown by Mr. Clark, but some of them get to be four to six

inches long before they are all seined out. I suggest that those fish culturists who are partitioning off the adults, try at least one pond in just the reverse method and feed the fish liberally to see what the results are. Certainly it is less expensive to eliminate these partitions.

Mr. Lydell: Do I understand that you recommend the feeding of the small-mouth bass during the spawning season? We feed our large-mouth bass during the spawning season every day, and have all summer; but as to our small-mouth bass, there were several days when they were nesting when we did not feed them.

Mr. Clark: They do not need it and won't take it then.

Mr. Titcomb: That is true.

VALUE OF AQUATIC PLANTS IN POND CULTURE.

BY MR. C. K. GREEN.

Two years ago at the request of the Commissioner of Fish and Fisheries the United States Agricultural Department detailed a skilled botanist to make a collection of the aquatic plants at Fish Lakes Station, Washington, D. C., and classify them.

It was known that the ponds were rich in water plants and it was the idea of identifying the different kinds and ascertaining the habits and manner and growth of each, especially those which were most abundant, that the request was made.

The city of Washington being recognized as a sort of botanical center, it is probably as favorable a location as could be selected for acquiring general information on the subject. The Fish Lakes Station has been called upon at various times to furnish aquatic plants for other stations. Some of the varieties are of great value both as oxygenators and food producers for the young fish; others, however, while undoubtedly possessing more or less merit in these respects, make such excessive growth and involve so much labor to remove them that their introduction to other waters is not advisable. In all fifty-eight kinds were collected and classified, including those which are semi-aquatic, requiring a great deal of moisture but not submerged, growing about the edge of the ponds. The two varieties which are the least desirable and cause the greatest amount of labor are *Marsilea quadrifolia*, the water clover, and *Potamogeton pectinatus*, the fennel-leaved pond weed. The *Marsilea*, I am informed, was introduced many years ago by Prof. Baird and procured originally from Texas. It presents a handsome appearance, growing on long stems, having a clover-like leaf and at certain stages a mass of it looks like a well kept lawn. I have been unable to discover that it possesses valuable food producing qualities but the chief objection to it is that it forms a net work of roots and grows so thickly that unless taken in early growth it is necessary when mowing, to cut it in chunks in order to lift it out with pitch forks. It apparently does not grow in water exceeding two feet so that it can be gotten rid of to a certain extent by deepening the pond.

Potamogeton pectinatus grows very thick and mats on the surface. After being exposed to the sun it becomes withered and brownish in color and decays, thus fouling the water. It is very heavy and requires much labor to remove it. The growth becomes so dense that the fish are unable to work through it and it becomes a great detriment, interfering also with the circulation of the water. It apparently thrives in all ordinary depths in ponds and I doubt whether there is any way it can be eliminated.

The next plant in extent of growth is *Anacharis canadensis*, commonly called water weed or wyme. It is valuable, however, as a food producer and does not grow so luxuriantly but that it can be handled with comparative ease if desired. It dies in cold weather so that unless in southern sections where the water remains warm the year around there is little danger of its proving obnoxious. The leaves are light green, small and pretty. I have observed young snails and other aquatic life clinging to it. As a rule it does not grow so heavy but that the fish can work about. It is said of this plant, however, that some years ago it was introduced in Europe by a traveler who was very enthusiastic over its handsome appearance and purifying qualities. The German Government ordered some to be placed in canals and attached a fine to any disturbance of it. It was not long, however, before it grew so thickly as to clog the canals to such an extent that the boats could not be navigated and now the government offers a reward to anyone who will devise a means for suppressing its growth. This is similar to the introduction of the water hyacinth in the St. Johns River, Florida. I grow this plant freely, however, at the Washington ponds as the cold weather invariably kills it. In order to preserve a stock it is necessary to transfer a few plants to the green house before winter opens so there is not any danger of an over abundance north of Washington. The suspended roots harbor quantities of insect food and gold fish spawn among them.

Probably, among the most valuable plants in all respects for food culture are the following: *Ceratophyllum demersum*, *Cabomba caroliniana*, *Potamogeton Crispus*, *Potamogeton foliosus* and *Vallisneria spiralis*. These are all excellent oxygenators and food producers. *C. demersum* and *C. Caroliniana* are es-

pecially good—the latter being the favorite aquarium plant both on account of its handsome foliage and cleanly habit. It grows readily in nearly all waters and is not especially particular as to root anchorage although it undoubtedly thrives best when drawing part of its substance from the soil.

About the edges of a pond the yellow iris is very desirable. It is very hardy, the roots forming a thick fibrous growth which half sustains the bank about the water edge, and during June the yellow blossoms are exceedingly attractive. In growth the plant attains about two feet; late in July it is advisable to mow it as the heavy seed pods fall over in the water and decay—the second growth comes on rapidly and remains the rest of the season but the plant does not flower again.

Lythrum salicaria, the purple loose-strife, is also a valuable and attractive plant about the borders. It bears pretty purple flowers on spikes, grows to about three feet in height and blossoms throughout the season. Like the yellow iris, it is a perennial and when once established takes care of itself.

Lily pads in moderation I believe to be beneficial, they act as sun shades and in still waters provide a cool retreat for the fish in bad weather. It is quite remarkable just under a lily leaf and outside of it in pond waters.

The lotus (*Nelumbo lutea*) while very beautiful when perfect appears to be subject to the ravages of insects to such an extent as to make it on the whole undesirable, at least this is the experience at the Washington ponds in one of which it grows in abundance. The banana-like bulbs penetrate three feet in the mud rendering extermination of the plant very difficult.

In conclusion permit me to say that I do not know that I have said anything with which many of the members of this society are not familiar, but in as much as the Washington Station has been frequently called upon for an assortment of aquatic plants for other localities, I concluded it might be interesting to set forth the varieties usually selected with the reason therefor if there is anyone present not familiar with the names of the plants mentioned who would like to identify them I will say that the preserved specimens are here and can be examined if desired.

The growth of aquatic plants in ponds, particularly those designed for bass culture, is such an important matter, both in

the way of producing food, purifying the waters and providing shelter for the young fish, that it would appear very desirable to have a free exchange of knowledge along this line.

DISCUSSION.

Mr. Stranahan: I prepared no paper for this meeting and I would like to say a little with reference to these aquatic plants. They are with us of the very greatest importance. We have had to make a good long fight of four years to know what to use and what not to use and how to use it. We have settled down to two plants, in neither of which am I sure of the scientific name. *Myrriophyllum* is the name of one of them. That plant does well in our more fertile ponds. In the other ponds which are very sterile (sand, clay and gravel) we have found the parrot feather, one of the *myrriophyllum* family, I believe, a splendid plant for use. We have to plant it every year to some extent; it will get killed out unless it is looked after, but it offers us an abundance of cover; and we were derelict to the extent of losing quite a number of thousand of bass this year by not having planted our *myrriophyllum* early enough in one of our ponds. The parrot feather makes a good heavy cover for the protection of small fry, and furnishes a home for daphnia and cyclops, and all those crustacea that are good food for our little fishes. Where we have it we take out large quantities of bass, and where we do not have it we fail. I got these ideas of the necessity of a heavy cover from Mr. Leary's ponds. I was sent by the commissioner to San Marcos to see Mr. Leary's ponds, and with all due respect to his ability as a fish culturist—he is an industrious, hard-working man—a very large portion of his success, in my opinion, comes from his magnificent cover of *myrriophyllum*. His ponds are right, his soil black and deep, and he has to mow his weeds to clean up his ponds.

Mr. Leary: Yes sir, two or three times during the summer.

Mr. Stranahan: We could not make *myrriophyllum* grow in our poorer ponds, and had to take the parrot feather. If we had that parrot feather in our richer ponds it would overrun us. We regard the matter a good cover as one of the three important points in bass culture referred to in my paper at Woods

Hole last year, (A) abundant food during breeding season, (B) abundant cover, (C) planting of the fish as fast as they are large enough to plant. Do not allow your ponds to become overstocked with little fish. In fact we believe we plant just as many of the larger size as we would if we did not plant the smaller.

Mr. Dean: What time does Mr. Stranahan plant this parrot feather?

Mr. Stranahan: In the fall or spring in the ponds, just throw down a handful where we take a spade, raise up the soil, kick the parrot feather in and tramp it down. Or if the soil is too hard weight it with a stone. We can maintain fine growth early in the season. It is pretty much gone now owing to hot weather; it won't stand the hottest weather but it serves its purpose all right, because we have it abundantly until our fingerling are distributed.

Mr. Robinson: I would like to ask Mr. Stranahan if it will do well in water down to a temperature as low as 32 degrees.

Mr. Stranahan: Our water never gets that low in temperature. Our spring water is 62 degrees in winter. I believe as far north as Virginia and perhaps further north, that parrot feather would live all right. If any one would like to make the experiment I would be glad to send him some parrot feather for that purpose.

Mr. Robinson: I would like to do that.

THE UTILIZATION OF NEGLECTED FISHES.

BY CHARLES G. ATKINS.

In all the fields in which man has sought to turn the productions of organic nature, either animal or vegetable, to his own profit, his procedure has been characterized by great wastefulness, but I doubt whether there is one in which this has been more pronounced than in the fisheries and the utilization of their products. Not only in the preparation of fish for food, is much thrown into the gutter that might have gone into the pot, but, to go back to the first step, the catching of the fish, there are whole tribes of fishes whose capture, unwillingly affected, involves on the one hand lamentable sacrifices of time and financial losses, and on the other hand destruction of nutritious or otherwise useful material on a prodigal scale.

The fresh water fisheries occupy a narrower field than those of the sea, and are not characterized by the same degree of prodigality, but even here there is good ground for doubting whether the resources of the lakes and rivers are utilized as they should be—whether there are not some useful species wholly or partly neglected or wasted. There has, to be sure, been important progress in recent years, and some species once wholly waste are now regularly marketed for food. In Lake Erie, I am informed that there still remains, among fish sufficiently large and numerous to be considered important, a single species that is not utilized at all, namely, the *ling* or *lawyer* [*Lota maculosa*], a fish quite plentiful in spring and fall, following the different run of fish that are spawning—great spawn-eaters they are, and also very destructive of the schools of minnows and other small fishes. Considerable quantities of them are incidentally caught in winter by hook and line through the ice, several tons being taken each winter in the vicinity of the islands. They are said to be very good for food when smoked like sturgeon, yet they are not used.*

In the sea fisheries, also, we find that there has been commendable progress in recent years. Several species of fish formerly neglected have come into use as food, in some markets, and

appear to be gaining ground. In this category may be mentioned the horse mackerel or tunny [*Thunnus thynnus*] and the whiting or silver hake [*Merluccius bilinearis*], and there is even a beginning of the use of sharks, skates and sea-catfish or wolf-fish.**

It however remains true that several marine species, which are abundant enough on the coast of North America north of the latitude of 40 degrees to be at times dreadful pests to fishermen, are practically unutilized. Foremost among these are two species of skate, [*Raja*] and the common dogfish [*Squalus acanthias*.]

The skates are large fishes of flattened form and rhomboid outline, the smaller species not generally exceeding twenty pounds weight in Penobscot bay, the larger attaining a weight of seventy pounds. Among other disagreeable traits they have the habit of eating small crustacea and are accused of preying on young lobsters. They are of good quality for food, but I have never heard of their being eaten except in an experimental way.

The prince of ravagers is, however, the dogfish, [*Squalus acanthias*]. This is a small shark with slender body, two or three feet long and weighing from five to fifteen pounds. It is found on both sides of the Atlantic, is very abundant generally on the shores of Canada and New England, and somewhat further south, being sometimes found on the coast of Cuba. Instead of laying eggs, the dogfish brings forth its young alive, only ten to twenty in a season, but of such extraordinary vitality and hardiness that enough survive to keep up the number of the species, with, however, great legal fluctuations.

On the coast of Maine the dogfish is chiefly a summer visitor, coming in June and leaving in August or September. As illustrating his habits and his influence on the shore fisheries, I will quote some memoranda from my note-book on observations made in 1902, on the fishing grounds near Mt. Desert Rock. It is estimated that thirty to fifty craft, manned by two hundred men or more, habitually fish on these grounds for haddock, cod, hake and cusk. In 1902 they were all driven off from these grounds early in July, by such great numbers of dogfish that few other fish could be caught, and had hardly begun their work again by Sept. 9. The fishing here is largely done with trawls. When the dogfish come, they not only take the baits that have not yet

**Report Mass. Comr. Fisheries and Game, 1903, and letter of Capt. J. W. Collins Commissioner

been seized by other fishes, but they fall upon the hooked fish, cod, haddock, etc., and eat them, leaving only the heads and parts of the skeletons. One fisherman with a trawl of 500 hooks, near Gott's island, took at one haul five haddock, a good many haddock heads, and 217 dogfish. Another trawler, the same day, on nearby ground, took at one haul two hake-heads, three skates and 224 dogfish. So destructive were the dogfish that it seemed to fishermen and dealers that unless some remedy could be found, there would soon be an end of all other fish.

Dogfish have been found very injurious to other branches of fishing. Mackerel seiners have sometimes found that when an especially large catch had been made—say 200 barrels at one set of the seine—unless the fish could be speedily removed from the seine, the dogfish were almost certain to attack the enclosed body of mackerel, biting holes in the fine seine, to get at their prey, and thus not only greatly injuring the gear, but in addition, letting loose all the mackerel they could not seize and devour.

So serious have the ravages of the dogfish become, that governments have been besought to interfere, and by the offering of bounties or by some other means, to assist in their destruction. A Canadian official report notes, as samples of the suggestions made by various people, eight different schemes for the war against them, some of which aim simply at their destruction, and others at some utilization. These suggestions are so interesting that I will read the whole list.

1. Liberate alive some hundreds of dogfish having securely fastened outside their bodies (by means of hooks, wires, etc.) glittering and gaudy streamers or jingling chains or bells, calculated to terrify and frighten away the schools of dogfish, on the old principle of setting at liberty a rat with a bell hung round its neck.

2. Inoculate a number of dogfish with some fatal or contagious disease, thus securing the infection and death of all the schools of dogfish which may hover near, on the principle adopted in reducing the pest of rabbits in Australia some years ago.

3. Dynamite the great schools of dogfish when they appear.

4. Employ the government cruisers and their men in cap-

turing these pests, or let the government employ special vessels for the purpose, until the plague is reduced.

5. Pay a bounty of one cent for every five tails of dogfish (\$2.00 per 1,000) brought to a fishery officer and after being officially recorded, destroyed by such officer. Many fishermen have declared that they get 1,000 dogfish in a single day frequently; yet it is asserted that even \$2.50 per 1,000 would not pay.

6. Pay a bounty on the basis of the weight of the dogfish captured, say so much per 100 pounds. Some parties claim that \$2.00 or \$3.00 per ton or half a cent per fish would pay the fishermen, while others say that, as the dogfish would average a weight of four pounds, such a bounty of one cent each fish would pay. Thus the suggested rates range from ten cents or fifteen cents per 100 pounds to twenty-five cents per 200 pounds.

7. Pay a bounty on the total yield of oil, a fixed rate on each gallon of oil produced by a factory being guaranteed to any firm or company carrying on reduction works.

8. Use long seines of strong cord, 41,000 yards or more in length, under departmental direction, and surround the schools, as is done with the schools of sharks in India.

Dogfish have not been found wholly useless. Their livers yield oil, and their bodies can be made into fertilizers; but their capture for the oil has been found unprofitable, and the presence of the oil has interfered with their use as fertilizers. The scheme that now appears to promise best, is for the public to apply their teeth and eat the dogfish up. There have been some experiments made in this direction, which have at least shown that the flesh of the dogfish is palatable, and that it is nutritious cannot be doubted. Investigation of this matter is in progress at the Laboratory of the Bureau of Fisheries at Woods Hole, a report of which, to be expected in the near future, will undoubtedly be of great interest and importance.

The Woods Hole investigation originated in a study of the conditions affecting the abundance of lobsters. It was found that young lobsters were the prey of sundry fishes and especially of the dogfish. Attention being turned to the utilization of the dogfish it was found, in addition to the yield of oil from the liver, which was already known, that glue could be made from its fins

and that its flesh, when properly prepared, was pleasing to the palate of many people.

A knowledge of these experiments led a canner in Cape Breton to can some dogfish and make a serious attempt to introduce the article to general use. His efforts have at least elicited very favorable reports from those who have eaten of the new viand.

Having thus possibilities of usefulness in three directions, we may indulge the hope that in the future, not very remote, this scourge of the coast fisheries may become a source of profit to the fishermen and of utility to the public at large.

In these remarks I have named but a few species of neglected fishes. There are many others that are worthy of attention, though in a subordinate degree, and let us hope that each will some time come to occupy that position in the ministry to man's wants which nature has marked out for it.

I commend to you, gentlemen, the fostering of this good work—the rescuing of good material for the sustenance and comfort of mankind from a position of neglect or something worse. Many of you are in positions which enable you to give effective impulses to the movement, and such impulses it certainly demands. Men in general are woefully given to moving in ruts—to moving, in the matter of sustenance, forever in the narrow groove into which ancestral prejudice or fashionable dictation has led them. To get out of their ruts they must be led out.

DISCUSSION OF MR. CHARLES G. ATKINS' PAPER.

Dr. Bean: I would like to ask Mr. Atkins whether or not he included the skate as one of the fishes which is not eaten.

Mr. Atkins: Yes.

Dr. Bean: The skate, it may be stated, is sold regularly now in the New York markets and doubtless wherever French people or their descendants are met with. As Mr. Atkins of course knows, it is not at all an unpalatable dish, and it can be found on the bills of fare of many of the trans-Atlantic steamers under the name of ray. It is really very good. It is sold doubtless in New Orleans and other cities which contains a large percentage of French population.

The dogfish to which you refer, I suppose is the horned or spined dogfish.

Mr. Atkins: Yes.

Dr. Bean: There is another little fellow, not so pesky as this one, but he is also very abundant—the rough dogfish. He is not very formidable, however, because his teeth are more like some of the teeth of the female ray without cutting edges; but he is a nuisance sometimes because he takes the hook intended for better fish, destroys the smaller fishes, and interferes with the fishery by consuming the food of the migratory food fishes.

Mr. Atkins: I am glad to know that the skates are really coming into use in New York, and I hope that they will come into general use, so that all that are caught on the coast may be utilized. Those caught on the coast of Maine are entirely wasted.

Dr. Bean: I am not able to answer that question, because I have never tried the dogfish personally—I have eaten skate and I think it is a palatable fish. I presume though the chief objection to any dogfish would be the toughness of its fibres. Its muscles are pretty well sheathed and the sheath is not tender. The steel-head salmon was not considered edible because the bone is so hard; but it is the chief fish now for export in a hard frozen state, and so we might go on and name a number of other fish that a few years ago, within our recollection, were not market fish at all, but which have now become quite important. Take the tunny for example, which is not only a celebrated food fish among all Italians and their descendants, but is quite a game fish on the California coast. So the taste in fish seems to be changing year by year, and it is quite an advantageous thing to learn about certain things that are regarded as nuisances and then a little later see them come into market and form a large portion of the food supply.

The blue fish was not eaten when I was a boy—nobody would eat a blue fish. The benito was regarded as only fit to be thrown away; and I could name a score of fish which have within my own recollection come into use.

Dr. Smith: I think the thanks of the society are due to Mr. Atkins for bringing up in so interesting a way the subject which is already very important and is destined to become much more so. I was glad to notice from the advance programme that he was going to talk on this subject, because it is one to which I have given considerable attention.

I am not going to say all I intended to say because the hour is late, but I wish to mention one or two points.

He has mentioned the whiting as having been brought to public notice through the Massachusetts Fish Commission. I do not wish to detract anything from the credit due the Massachusetts Fish Commission, especially as it has no representative present; but I believe that the United States Bureau of Fisheries is largely responsible for the importance which that fish has recently attained; as twelve or fifteen years ago (as our reports will show) we had samples of this fish salted on Cape Cod and distributed through the trade to consumers in Massachusetts and elsewhere. The growth in the demand for that fish has steadily increased, and a year or so ago when I was in Gloucester and saw one of the principal fish curers there, I found that he alone had salted and sold at very good prices, about one thousand five hundred barrels of this whiting which a few years ago had absolutely no value in the market and was regarded as a nuisance and always thrown away. It is caught in immense numbers in the traps on Cape Cod.

With regard to dogfish I would like to quote something that Mr. Bowers said yesterday and which he may have told some of the other members. He has just come from Woods Hole and has seen a dogfish about three feet long opened, and found to contain two eight inch lobsters. The lobsters are becoming deplorably scarce in that region and no doubt the dogfish, which is very abundant, is to some extent responsible for the scarcity.

Mr. Atkins: Let me ask whether you have any evidence of, or any notes in relation to, the question as to whether or not the skate preys on the lobster.

Dr. Smith: I have heard that stated, though I have no personal knowledge on the subject; but I will present a communication here which touches on it.

Mr. W. R. Hollaway, U. S. Consul-General at Halifax, N. S., sent the following letter to the Department of State, dated June 30th, 1904, in regard to the utilization of waste fishes:

The Halifax Chronicle publishes an interview with an ardent amateur fisherman who told of experiments and researches among the so-called dogfish, albacores and skates. He said his experiments as to the habits of the fish when alive and their edible qualities when dead had covered a number of years. He had discovered many things which no doubt the majority of the fishermen in the Maritime provinces would scoff at, but nevertheless they were facts and anyone with a mind to investigation could soon find it out for himself.

Speaking of dogfish in particular, he said that the flesh of this fish when properly cooked was one of the most delicious dishes imaginable—the meat being firm, white and sweet. Fishermen generally were of the opinion that dogfish is an oily fish, but as a matter of fact it is not—no more so than the codfish, because, like the latter, the oil is all contained in the liver. The flesh lends itself readily to drying and salting, and in such countries as Italy and Spain, where the fish is so well known, large quantities are cured.

He suggested that this might be worth looking into, that is, the possibility of finding foreign markets for cured dogfish, when a new field of money-making would be thrown open to the fishermen of the Maritime provinces. Certainly the fish could be disposed of in the Italian settlements of the near-at-hand cities, like Boston and New York, and even in local centres like Sydney. A few enterprising men should make the experiment on a small scale. Certainly, if the experiment was not a success they would be very little out of pocket.

Then as to skates, many fishermen who have spent their lives at the business, know that a single skate will demolish more lobsters in a season than any one, or possibly two, of their pots will catch.

Fishermen as a rule are not observing. They will go on year after year, catching the well known varieties, but they seldom take any trouble to study the habits of the fish—why they move in certain directions at certain seasons, what they eat on the passage, and where they go to. Skates can be taken at almost all seasons, and if the stomach of one should be opened it would be found, in almost every case, to be full of lobster, shell and all, for the mouth of this voracious fish is so constructed that the toughest lobster shell can be ground almost into dust. It is the skate that is doing more to deplete the lobster fishery than almost any other agency. And yet this same skate is an edible fish, being somewhat similar to the well-known "flounder" or "flat-eye" in taste; then, too, it contains more glue than almost any other fish that swims, which alone would make it profitable to catch, provided there were factories handy in which

the glue could be manufactured. Why shouldn't the dogfish and the skate be as good to eat as the haddock or halibut, and much better than the lobster? They are particular what they eat, live bait suiting them better than anything else, a marked contrast to the lobster, which is the scavenger of the sea—the more rotten and putrid its food the better.

In his conversation the gentleman said he thought it was merely a matter of superstition that the dogfish was looked upon with so much aversion, and this superstition could be traced back to the old Jewish law referring to clean and unclean animals, and no doubt there is considerable truth in it. However, there is no question but that there are far more edible varieties of fish than the Eastern Canada fishermen think, but prejudices are sometimes hard to overcome. At any rate, it would pay to do a little experimenting.

Mr. Atkins: I have a correspondent in the town of Prospect, Me., who has told me about setting a trawl in the river and catching a great number of skates, and finding their stomachs full of young lobsters.

Dr. Smith: These dogfish investigations now going on at Woods Hole were started by me two years ago, and I think the young man who has the matter in charge will get some very important results. The dogfish was surreptitiously served at the large mess-room at Woods Hole last year.

Mr. Clark: When we were there?

Dr. Smith: Whether you had a part in that I don't know. (Laughter.) The matron of the mess was told to say that it was Japanese halibut.

President: I had some of it. (Laughter.)

Dr. Smith: The fish met with great favor and many people asked for the second helping. When the matron was asked what the fish was she forgot herself and said Japanese nightingale. (Laughter.) The flesh of the dogfish is decidedly palatable, not at all greasy or soft. I believe the prejudice against the dogfish is the prejudice which is shared by the shark family, and I think it is entirely unfounded.

I will call attention to a little item which shows the value of sharks in one of our states. In the Charleston, South Carolina, market sharks are skinned and cut into strips and sold in bunches

of one to two pounds at ten cents a bunch. Some 30,000 pounds were disposed of during the year of 1897, when we made a canvass of the fisheries, and in 1902 the catch and sales had increased to 90,000 pounds, valued at \$1,800.

In the San Francisco market, where skates are eaten and various other things in the fish line that are not eaten in any other part of the United States, when sturgeon is scarce, skate is sometimes used as a substitute. The second alternative is shark. This is sold in restaurants under the name of tenderloin of sole and I ask you to beware of the tenderloin that you in San Francisco, if you expect to get a tenderloin of a fish that does not occur in the United States. (Laughter.)

Many years ago there was established a special fishery for the common gar in the Neuse river in North Carolina, and although that special fishery no longer exists, I believe, still in that part of the state, as Mr. Worth knows, I dare say, gars are very commonly eaten, usually by the negro population, but sometimes by white people, and one of the characteristic sights along the water front of the town of Newbern on the Neuse river, is a negro man with his foot on a gar ripping the skin off with a jack knife, and I am told gars never go begging in that region. They are easily marketed at five and fifteen cents apiece. I saw several sold by fishermen (who had brought them in with their herring) at fifteen cents apiece.

Mr. Lydell: I should judge from this paper and from the talk, that the United States Fish Commission would like to get rid of these dogfish; that they are a pest; therefore I move that they be classed with carp of Pennsylvania.

Mr. Atkins: I think that was a good suggestion and would add that they both be brought into the market and used regularly for food and perhaps we shall conclude that instead of a curse they are a blessing.

Mr. Seymour Bower: Speaking of the different kinds of fish that have become very valuable, but which were once of no value, there is no more striking illustration than the sturgeon of the Great Lakes. You can find commercial fishermen in Sandusky and Lake Erie alive today who remember when sturgeon were

thrown away. They were gradually put on the market at twenty-five cents apiece, and the demand was limited. In 1880 the going price was \$1.25. Today in Detroit river a female sturgeon in the month of June sells quickly, at first hands, for \$15.00. So you see there is a marked change in sentiment in the use of that particular kind of fish.

I remember when the lawyer or eel pout were absolutely unsaleable, but today I think every one that is caught finds a market at some price.

A few years ago buyers were buying up sheephead and they went on the market as shredded codfish.

A number of years ago I was associated with Mr. Stranahan, and I have often heard him state that he believed that there was no living animal that was not suitable for food. Perhaps some of them were not particularly toothsome or palatable, but still they were nutritious and wholesome. We have an animal in the Great Lakes called the menobranchus, mud puppy, or "water lizard," which is very repulsive in appearance, Mr. Stranahan took the ground that they were excellent food, and predicted that in time they would be regarded as a delicacy, like frogs and turtles, which by the way, not very many years ago were not themselves eaten. One day we caught one and Mr. Stranahan dressed it, put it on a shovel, placed it in the furnace, under the boiler, cooked it and brought it out, and said he wanted a witness that he had eaten a mud puppy. He invited me to participate in the feast. Well, it did look really inviting, it smelled delicious and the flesh was white. He used salt and pepper and butter, sat down and ate it and said it was good—I can testify to that—and I have no doubt that he is right in his prediction that in a few years they will be considered a delicacy and bring as good a price as frogs and turtles do today.

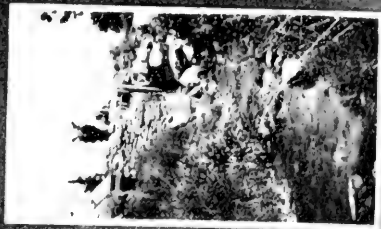
Dr. Bean: There is another fish in the Great Lakes which fifteen years ago was scarcely thought of at all, and that is the lake herring, now one of the most important fish of the Great Lakes. The price has advanced from about two or three cents upwards.

President: Half a cent.

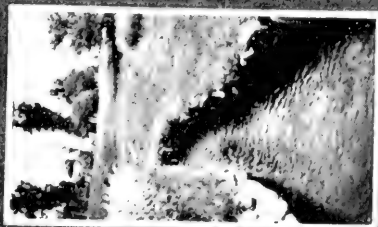
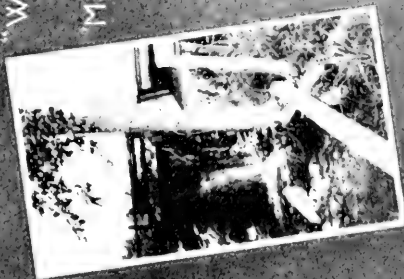
Dr. Bean: When I first noticed it it was two or three cents in the Washington market. Now the same fish sell very readily from fifteen to eighteen cents.

President: When I first commenced work on Lake Erie in 1873 or 1874, herring was sold at fifty cents a box, holding 200 pounds. I positively know that seven cents a pound was paid for herring wholesale last year.

Mr. Leary: We have a fish known as the alligator gar which is very destructive and bad. The Givens Packing Company at Corpus Christi, Texas, experimented with the roe and shipped it as caviar, and Mr. Givens told me that the roe sold readily, but the only difficulty was in getting a seine strong enough to hold and capture the gar, and I have no doubt it will be utilized some day and a profit made on it.



Where waters
rush
Mid quivering
foam



RESUME OF WORK DONE DURING THE PAST YEAR IN THE RAISING OF WESTERN CHARR IN EASTERN WATERS.

BY DR. F. M. JOHNSON.

Mr. President and Members of the Society:—The subject of my paper to you today is simply a resume of work that I have been trying to do in the past year in the raising of western charr in eastern waters.

Hidden among the hills of New Hampshire there is a spot that I chose for this particular work, on account first of the water supply, the purity of the water, and according to the surface I found that I had sufficient fall between the headwaters and my pond to give magnificent aeration. The headwaters come from a lake called Kolelemook. The outlet of this lake fed two or three small ponds that at one time were used for mill purposes. These, in short, I reclaimed, building culverts underneath the roadways, taking away the large pipes, and trying to put each and every one of the small ponds into what I considered a better condition. Two ponds, one already completed, I have added to the water-course in the meadow land connected with the old farmhouse. By the kindness of Commissioner Bowers, to whom I early went when I had this scheme in mind, I was supplied with the fish with which to make certain experiments. At that time I had in one of the ponds, our native brook trout; in a pond below it I had the specimens of the western trout, the rainbow or the salmo iridius, and it was my intention to keep them apart and watch them, their feeding and their processes of life. Unfortunately, as I thought at that time, but it has proven fortunately since then, the upper dam had some leakage in it, and it was stopped up in the winter time, one flowed into the other and mixed the two varieties up. I thought at first when I discovered this that it was going to block my entire plan. Instead of that it has given me the subject of my paper today, for I want to draw out one or two factors, and one of them is the harmony in which the brook trout and the rainbow apparently live together.

Now, gentlemen, I have not followed this in point of time

long enough to give you anything but the conjectures of the year and a half during which I have been noticing these special factors.

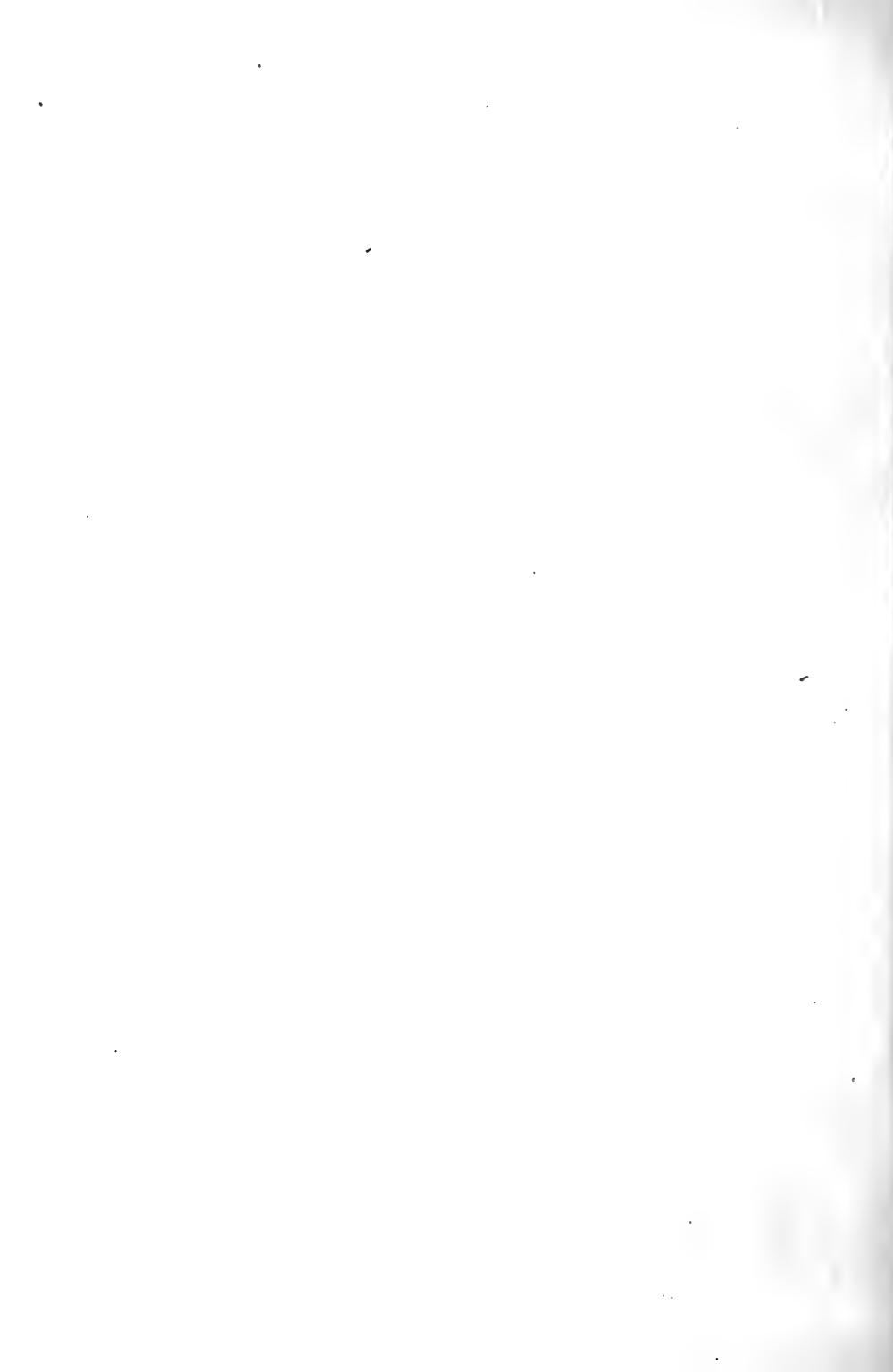
I am convinced of one thing, that there is less quarreling, less inquisitiveness, and fewer criticisms passed between our *salmo iridius* and our *salmo fontinalis* than you find occurring when you get five or six or ten families in an apartment house.

The western charr, as you all know, comes from streams that flow through magnificent ravines oftentimes in sturdier waters. The fish as they came to me from the hatchery, as near as I could glean from the specimens shown here yesterday, were what might be called baby fingerlings. They varied a great deal in size. They still had certain characteristics as they grew older, of the rainbow trout in its native heath.

I at first fed the trout. I have always been opposed to feeding trout or fish of any kind on any artificial food if it were possible to approximate the foods that nature supplies. So I can say that up to date I have not been obliged to feed any of the fish that I have been raising on any of the ordinary so-called foods comprising liver, etc., etc. I have found that the natural supplies of foods I could always obtain. In the neighborhood of my pond there was a tremendous quantity of good old fashioned elusive tidbits called the angleworm or the earthworm, that the fish preferred to anything else. While the fish were quite small I secured worms, chopped them into small pieces, and fed the fish regularly with them. As they grew older I no longer chopped the worms up but threw them in whole. Of course they were devoured very eagerly, and in an amusing manner, because the little fellows would often each get the end of a worm in their mouths and have a sort of tug of war until they pulled the thing apart, or yanked it one from the other. The fish grew well. I tried one or two foods for experiment—not that my fish needed them—because, as I say, I had a good supply of worms there—but I tried a food that seemed to me to be a cheap one, good and nutritious. I tried it simply to see if the fish would take it, and it went far beyond my expectation—I refer to well cooked vermicelli. I cooked it with a meat bone and salted it well, then chopped it in small pieces (not too small) and threw it out over the waters and the result was marvelous. The vermicelli being



HEADWATERS—LAKE "KOLELEMOOK."



white looked like an angle worm, but much whiter and clearer, and I do not think there was a piece that ever rested on the bottom so far as I could see. I simply suggest that sometime when your supply of liver may be a bit tainted and you cannot get just what you need, you try vermicelli. It cannot hurt your fish any; they ought to thrive on it, the Dagoes live on it, and there are some clever Dagoes! (Laughter.)

Now I am going to pass you around some photographs which will perhaps show you better than I can tell you the different arrangements of these small ponds. Some of them are repetitions, some of them are different views, some were taken before I had the pond in my meadows; so you will pardon me if I seem to give you a superfluous number. They are all numbered and if you keep the numbers you can see about how they run.

In the winter months I have not had to feed the fish at all—in fact you cannot feed anything in the waters in Springfield during those months—you can chop ice as long as you like, and that is about as near as you get to the fish—you will still be chopping in the spring. (Laughter.) They are never seen and nothing is heard of them; they come up in the spring—I do not know where they come from, but they are fat, hearty and have spots on them—no change of color. I suppose they live by burrowing in the mud, and get nutrition there.

Thus far I have been rather fortunate in having no diseases appear among my little finny tribe. I have seen in some of the hatcheries one or two interesting conditions—perhaps one that I would like to speak of, because it might help you a bit looked at through medical spectacles. Through the courtesy of Mr. Hubbard, commissioner at Nashua, New Hampshire, while I was making him a visit we were looking at some of the rainbow fry (they were fingerling at that time) and they were dying rather rapidly that morning. Without any apparent reason the little chaps would turn over and give up the ghost very readily; and as we tried to trace the cause, we found that Boston was so excited over some Gen. Hooker day or something that they had down there that the market men had not sent the liver on time, and the last feeding on hand at the hatchery had probably become a little tainted. Now I took one of these small fish and performed a very delicate post mortem on it, and found that the disease was a

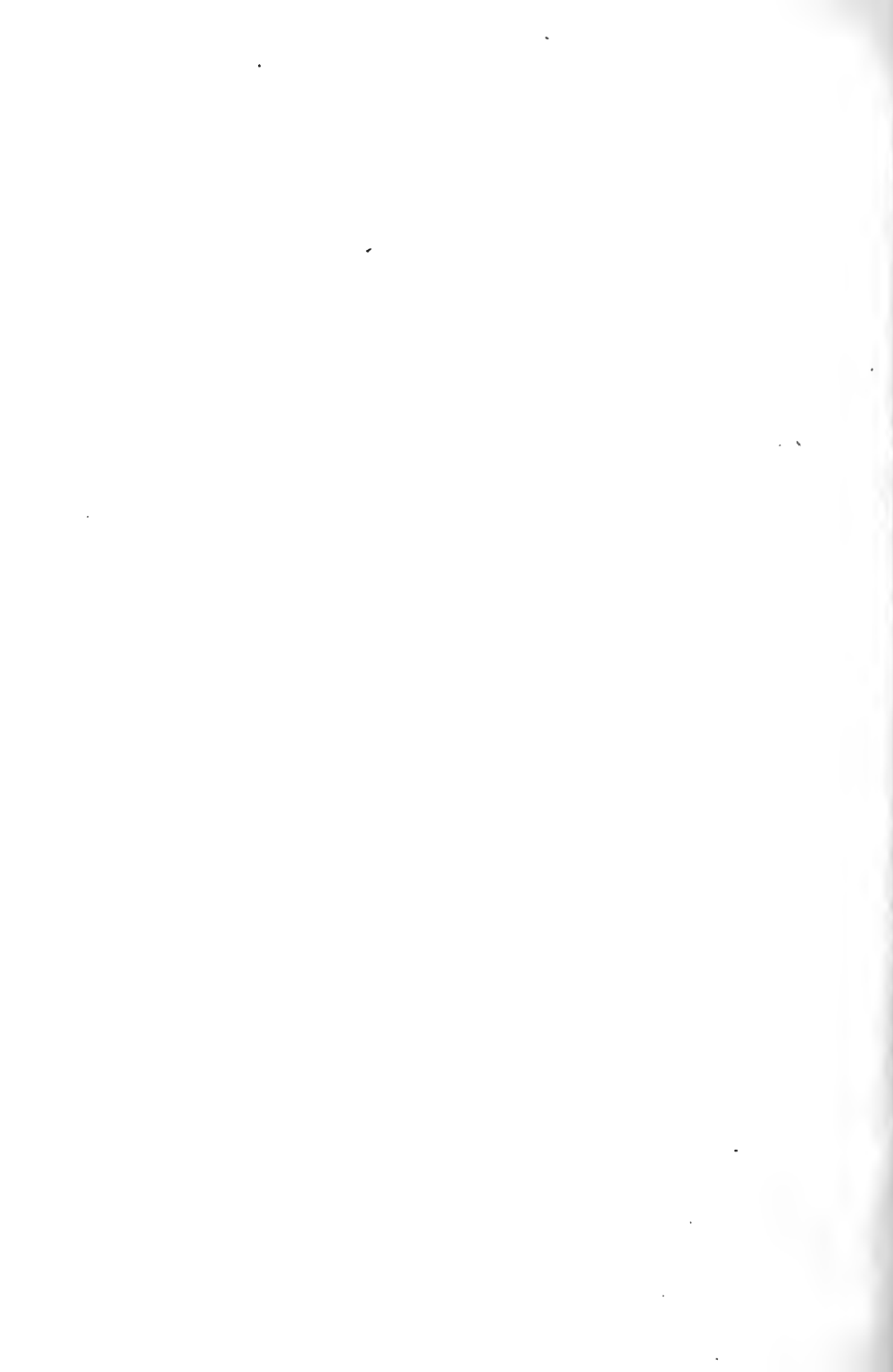
gastroduodenitis, which means intestinal disturbance from indigestion, that the food was not digested at all, that there was a sort of stoppage in there which produced probably abdominal colic in the fish and reflexly caused the heart to peter out, and subsequent death. It is well to remember that sort of thing because I believe you can eradicate a great deal of it by influencing your foods before you put them into the water.

There are other foods that are most excellent, and they are natural foods, if they can be obtained. The first one, and one it seems to me I have not heard many people speak of yet, is maggots; and there are maggots of all sizes. It is easy enough to hang somewhere in the course of a brook, upon a bending bush, a piece of meat, or a piece of fish, and allow the maggots to form and drop into the water; these are taken very eagerly by every sort of fish that swims, but I think that the trout particularly like them. The land-locked shrimp are to me one of the most important food for fishes, and one of the most dainty things that the fish can feed on; but it seems very hard work to know how to get them. I have been trying fruitlessly to get some of them. The land-locked shrimp is the most delicate of piscatorial bits for fishermen, and is the one food supply that if you get too many of them interferes with the sportsmen, because it feeds the fish so well that they will not come up to a fly. That is the trouble in Sunapee Lake, where perhaps so far as variety goes I do not know a place in the world that has as many different kinds of fish living in its waters—black bass, pickerel, land-locked salmon, German trout, the Loch Leven trout, and the Sunapee trout, along with white perch, and all the different pond fish. Now these are all fed tremendously well on the land-locked smelt. The trouble in ponds such as I have is that they are not deep enough to raise these land-locked smelt in. You must have depth of water. They like to live in from fifty to seventy-five feet of water, and if you do not get cooling water for them to live in they are simply eaten up very quickly and your food supply is gone.

We talked yesterday about ponds in a good many ways, how to build them, etc., we went over that subject very carefully. I do not know as I have a great deal to add, but perhaps there are one or two suggestions that I found of use in some ponds that I



POND No. 1—SALMON.



made myself to which I might refer. I am rather a crank on following nature. I go back to it every day in my life in medicine. With every new fish idea that comes I simply try to imitate nature.

When you get to a bit of clay soil it is not wise to always dig out all the clay. Clay is an important factor and it is well to leave a certain amount of it. At times you want your streams to wash out everything down to your gravel beds. If the nature of the soil is muddy do not clear out all that muck; leave it and let the water overflow it. I have taken out the boulders, and where I have excavated down deeply I have built rockeries out of them, so that when you flood back you cover all your rockeries. That gives a magnificent place for the fish to hide that they may get out of the sun's rays; and it is a good place also for them to feed. They like it. Of course gentlemen who are raising fish as you are, where you have to send them off, might say that these rockeries might interfere when you drew your water down, so that you could not get the fish out readily. That does not bother me much because I have such a tremendous fall—seventy-five foot drop—250 gallons a minute pouring out for aeration. I have built my ponds (those that I began on) myself; it is hard work to take up the old stuff and do much with it; and I have excavated it so that I can drain it perfectly.

I made a mistake at first in not putting in raceways; that was serious because in the spring the water rose so high it went over the top of the dam. Now with the raceways in that fault is eradicated.

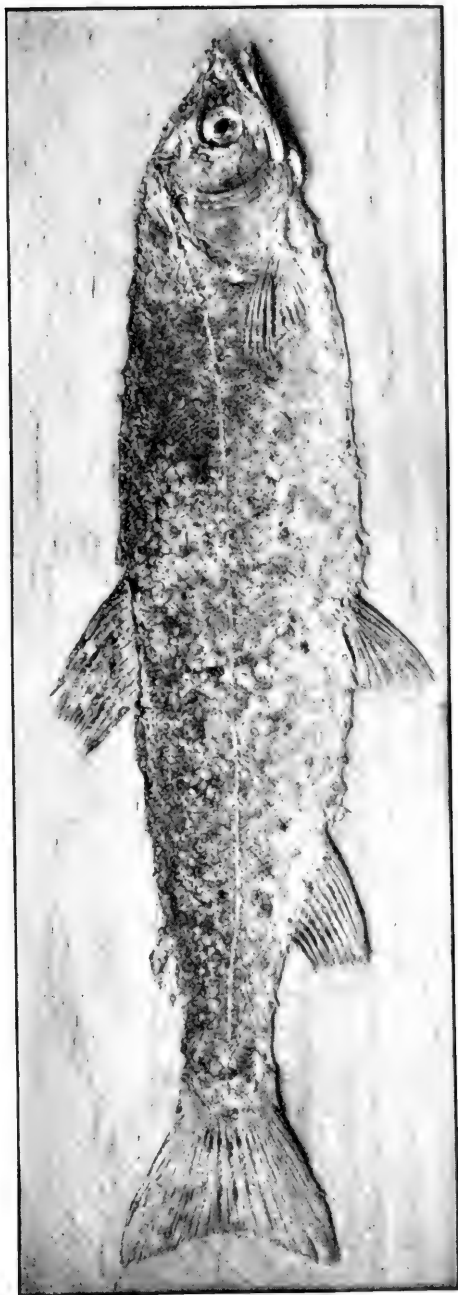
You will see on one of these photographs what fish are supposed to be in the waters. I suppose where this is marked "grayling" that the graylings are there; it is a supposition on my part because no one has ever seen them since the third day they went into the water; they have not appeared against the screens; there is nothing in there to eat them; they are not on the surface. There is a culvert and a bridge there, and Dr. Henshall thinks perhaps they are hidden away somewheres in that vicinity. If my attempt to raise the grayling this year does not prove successful I will adopt a somewhat different plan next year. I shall let the eggs hatch in a natural stream, and I believe that nature will have endowed them with common sense enough to take care

of themselves, and I rather fancy that if they are going to do well in eastern waters they will do well there. Again these chaps that I have already put in there may turn up.

I have noticed that from time to time the natural course of my brook gets diverted, through becoming jammed up with debris, and every spring I clear it out and restore it to its original course, now and then fashioning out little places that have been choked up with sand, going underneath the bank and making cool places for the small fish to lie in, preserving, as I say, the original course of the stream, making tiny falls wherever I can, thus increasing the oxygen in the water, and oxygen means life. I scoop out and take advantage of sandy places.

However in one respect I have interfered with nature, for in one place I have turned the natural place of the brook in a meadow through which it flows, taking it out of its proper course here where it used to run down by gravity, swinging it around to one side and thus securing more stream and a better spawning place and a sharper fall from it just before it goes into the pond. That is the only place where I have interfered, if you may so call it, with nature, and I think I have gained by having more feet of brook, and I now have a place where I hope some of these fishes are going to spawn this fall.

There is no pretension in the little specimens I hand around to you (showing two specimens mounted on boards—rainbow trout nine and three-fourths inches long, brook trout seven and three-fourths inches long) of anything except to show you the approximate length of these two fishes. The gorgeous coloring of our brook trout (which caused a poet to say that when they sprang into being the rainbow smiled), and of its companion, the western charr, who has belted himself with the same prismatic colors, is lost in these specimens, because the skins have been in pickle, and I did not try to have them mounted or painted because I wanted to show you merely the relative sizes of these fish. I tried to get you specimens exactly alike, but it was an impossible task. If I throw a fly now the little fellows come so rapidly, particularly small trout, that it is very hard work to get a larger specimen, and I did not care to risk getting the fishes in a net because I do not like to handle them any more than is absolutely necessary.



RAINBOW TROUT $9\frac{3}{4}$ INCHES LONG.



You will see here, and it is fair to make the supposition, that (in my very humble and limited experience) the iridius grows sturdier, heavier, and faster in every way than his companion, our native brook trout, on exactly the same food, and giving them the same waters. The rainbow is a cleverer fish as far as growing heavy goes—that is, it is true of these waters in New Hampshire; I do not know about other men's experience; but with me these fish were of exactly the same size; they were little fellows, probably fingerlings, all of them, and I think the rainbows were even smaller than the supply I obtained in my brook of the brook trout. The latter were more even in size. The rainbows varied—there were some small ones and some big ones, and I know that there are rainbows in my ponds today that are very much larger than these specimens, for I have fed them and seen them, but I was not clever enough to catch them. As you will see, the largest one of these specimens is the rainbow.

That, gentlemen, is about all I have to say of the brief observation that I have been able to give to this subject. Of course you will understand that while I wish for your sake there was more of scientific deduction or something of worth in my remarks on my work, yet it represents perhaps one phase of fish culture that you do not look at, to a person like myself who has taken it up, not only because he is interested, call it a fad if he will, but because it represents recreation, and it represents to me another important factor. You gentlemen who are fish culturists have not time and perhaps have not quite measures to try certain experiments that I might be able to do for you. You cannot use your ponds as I can. They are business ponds. They have their mission, you are asked to do certain things with them; while nobody controls my pond except me.

If a knotty problem comes up at any time where you want to try a certain experiment then I propose to have Lake Kolelemook and its addenda placed at your disposal each and every time that anything arises that I can help you solve, if you feel that you can leave it in my hands. Such is the desire and such is the intention of this little set of ponds whose photographs you see today.

Now perhaps I have gained the name of being very enthusiastic, but, gentlemen, there is one other side of this question that

has been lightly touched upon. It has not a commercial value, it is not purchasable by any amount of gold. You cannot trade it in the market for diamonds. The tired-out man of business goes to the woods and there he crosses hands with nature. There he receives ten fold back from her in every conceivable way, gifts that he in no ways has given her anything for. He learns to love what? Not only the beautiful fish, but, as he becomes a culturist, he appreciates more keenly what these things mean, while nature gives him absolute rest and bestows the beauties that he can appreciate, of sky, of the thunderstorm, of the charm of fleeing cloudland and peace—perfect in its purity. Everything is beautiful, everything is worth study, and all means to him health, rest to his nervous system, without being away and becoming lazy, without simply doing nothing. These things interest the business and the professional man and you want a few of us on your side. We may not amount to much as fish culturists, but you may need a few of us. Sometimes we can aid you in other ways, by keen appreciation of the magnificent work you gentlemen are doing all over the country, and I have noted as the years go by that the number of true sportsmen, and lovers of nature, are increasing; there is a great difference between a sport and a sportsman, and becoming a true sportsman. Many a man calls himself a sport (I suppose he is) I don't want to go into that phase of it, anyone who will catch a fish with nine hooks in him—he is a sport, perhaps, but he is not a sportsman or fisherman. Now you are training men far beyond what you think. You are helping me out. What you have said here today has encouraged me to go on with my work. You are preserving for future generations specimens of fish that would, without your efforts, soon be eradicated. Unless we are constantly doing something, the good species would soon be caught out. You should, gentlemen, appeal not only to the true sportsman of America, but you will help men who naturally give up their lives as fishermen and to whom it is a legitimate business, and worst of all you will have to supply the losses caused by the awful invasion and happenings all over the country, that genus that we call the fish hog.

Do the rainbow and brook trout live in harmony? I consider they do, anyway they grow up together in friendship. Perhaps



THE BROOK—BETWEEN PONDS No. 1 AND 2.

after a long period the Morgans of obesity will absorb smaller fry and create a trust, but this has not yet come. I prefer not to give you their astrological chart, therefore the future is hidden. We now deal with the present only. My attempt being to show you certain results within a certain time. Having but little spare time, I feel that these observations must be exceedingly crude. My experiments or deductions are only those of a tired-out man, whom, when the chance comes, flees to a forest home, where Dame nature gives rest and peace in her generosity extends much and asks but little. The elixir that permeates the sweet, soft cooling breezes, the purity and benefit derived from the crystal waters of deeply hidden springs, the songs of the feathered life of woodland, the very hum of the insect world, the azure blue of heavens, the wonders of cloudland amid sunshine and storm, the hush of the twilight, the fury of tempest, the lullaby of the pines that sigh, the greeting of dainty blossoms smiling through dew, or perchance the lonely cry of loon or hoot of owl, the startled whirr of wings, strange snapping of twigs, as some animal rushes from a nearer acquaintance with a human. Then what delicious fragrance comes from the aftermath of a summer shower. Now an impertinent spark of life seen in the ever vivacious chipmunk, who greets you with a noisy chatter then scampers into security at an approach. Fruit and berries in their full abundance of deliciousness can be ours by the mere taking. Shade, grateful and refreshing, and a couch that crushes us into comfort in its embrace. All these are but a few gifts of woodland's treasures. Then is it to be wondered at that we become lovers, and in every case, true sportsmen?

(Applause.)

DISCUSSION OF MR. JOHNSON'S ADDRESS.

President: It is certainly very interesting to us to hear the experiences of Dr. Johnson who has entered into this matter for the love of it and for recreation, and it is not often that we hear from those that are engaged in that manner.

Mr. Atkins: I wish to express my own gratification that Dr. Johnson has engaged in this experimental work. I think that we may look forward in the future to great changes in our practices.

and all such experiments as he is carrying on must help us in getting at the right method.

Mr. Whish: I also have taken great satisfaction in listening to this paper, but for a different reason. When Dr. Johnson spoke of *gastro-duodenitis*, I saw a ray of hope. He says he is raising the *fontinalis* in his pond. Now the brook trout, the old fashion speckled trout, the wild trout, in the hatcheries of this country is a diseased fish. The state of New York this last year lost 3,000 three-year-old brook trout in one hatchery, in spite of the best scientific attendance we could get. We do not know the cause of that epidemic. We do not know the name of it—do not know how to prevent it or whether it will ever come again, and, knowing, as I do that the same thing, or something of a similar nature is happening in the hatcheries of the United States commission and the hatcheries of other states, I think that here is a field where a man of the ability of Dr. Johnson, who has the time and means, can enter to great advantage.

Briefly this is what happened to our trout. If anybody recognizes the trouble and can tell me what it is, I will be very glad. In the stock ponds a large fish would suddenly leap from the water, dart violently from side to side, and then drop like a stone to the bottom where he would not move. If you took him out you would find, particularly along the dorsal aspect, what looked like boils, containing a mixture of blood and pus. In about three days those boils would break and he would then turn over on his back and die. Those boils, if they broke, left a cup-shaped ulcer which a physician would recognize as being a form of ulcer which accompanies a very vile disease in man. Whether this is a species of that disease in fish or not I do not know, but the fact remains that we lost everyone of our brook trout; it did not attack the fingerlings or yearlings, but it killed off every one of those magnificent brook trout in that hatchery. We have cleaned the hatchery out completely, putting in new cement bottoms and sides to the ponds and we have arranged the water supply so that we can cut off one pond from another, and we hope to prevent a recurrence of the disease.

I might tell you about fungus disease and parasites, but you know all about them, and I earnestly make the suggestion that



DAM-POND No. 2 AND BROOK BETWEEN PONDS No. 2 AND 3.

men of the ability and resources of Dr. Johnson take up this study of diseases of trout and of other fish. I got a wail from a man in the Adirondaeks a short time ago. He wrote me, "Black bass diseased. What can we do?" I asked him what was the matter and he said: "The large fish have what looks like a scale raised up on the side in various places, as if a No. 6 shot was under the skin; but you take that scale up and you will find a grub under there." I do not know what the disease is, but I know that the bass are grubby in many waters. We cannot control these conditions in wild waters, and when you get down to your hatchery ponds it is very serious. I have been unable to find any literature on this subject that would in any way reach the trouble we had. I might as well tell you where it was, it was at our best hatchery, Cold Spring Harbor, Long Island, and in my judgment it is similar to the disease that happened in a private preserve there eight years ago, which was investigated by a prominent professor who said he would take it up further in his laboratory, and who wrote me from Italy a short time ago that he had not had the time, so that we do not know what caused the disease.

Personally I am very well satisfied that you know now as fish culturists how to feed your fish, how to propagate the best kinds for various waters, but, gentlemen, I do not believe there is one of you who outside of salting the fish for certain troubles, knows anything about the dangerous diseases. I sent to Germany a month ago for an essay or treatise on diseases of fish by an eminent fish culturist, and I found in it a lithograph showing a form of trouble with the barbel, which he calls the "Beulen Krankheit." It looks very much like the trouble we had with our trout.

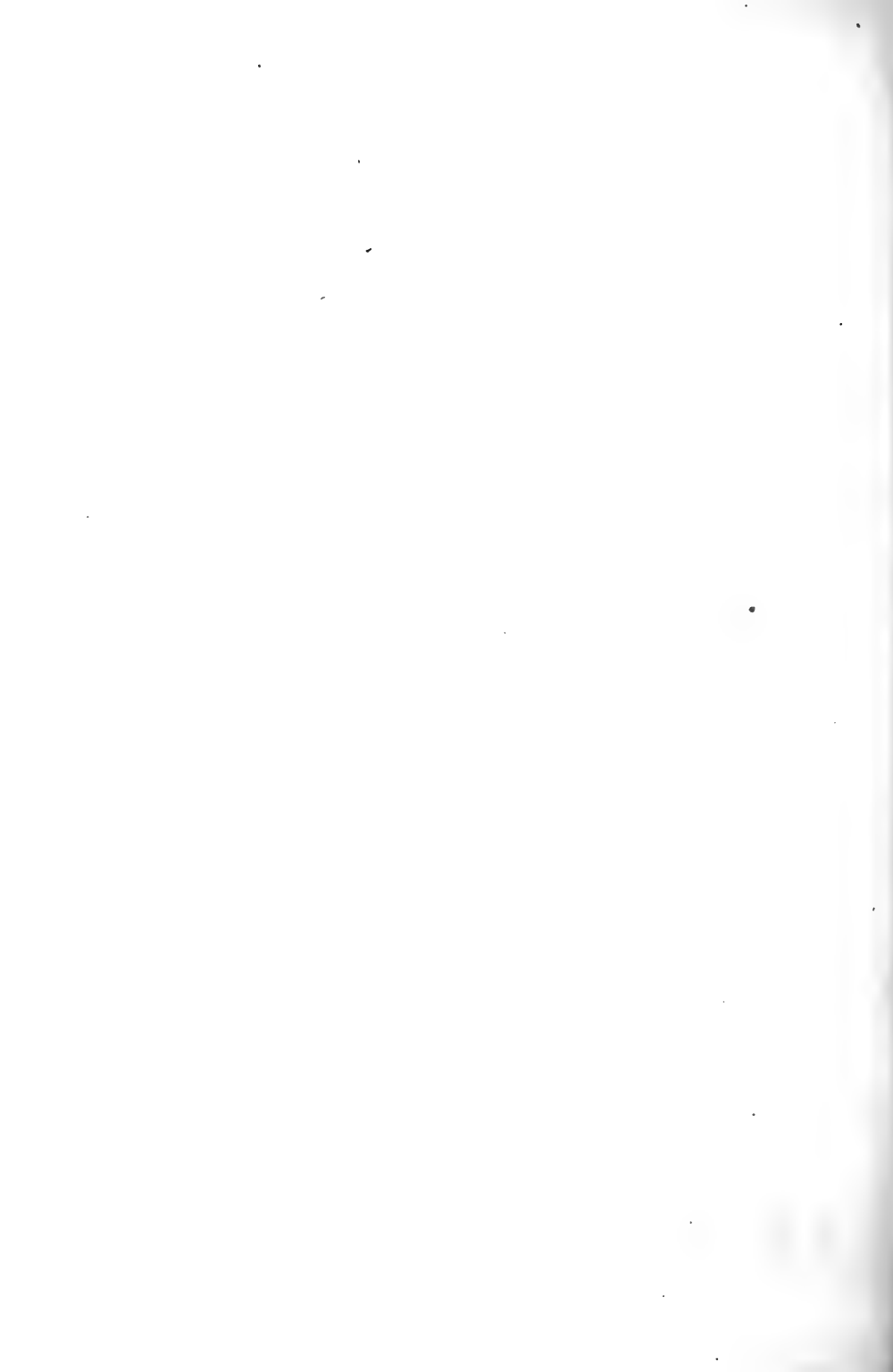
Mr. Meehan: My interest in this paper is the same as that of the gentleman from New York. We have had trouble also in Pennsylvania with diseases of fish, and in one particular case, only a year ago, in a hatchery which we have now abandoned, at Allentown, we had a large quantity of trout fry which, for reasons we were compelled to retain in our troughs beyond the time that they should have been kept. The fish began to die and before it could be stopped over 300,000 had died, fine fish, that were transferred to the ponds outside died in the same way. We

sent word in regard to the disease to the United States Bureau of Fisheries, and the Bureau sent a man to look into the matter. He remained there quite a while and went over the matter very thoroughly. He made his report and even he seems to be somewhat at sea as to the causes of the trouble. Undoubtedly these fish were decidedly anemic, but what caused that anemia in the fish we do not know. We had trouble several years before—I think during the great blizzard we lost something like 2,000,000 in about two weeks. I submitted a paper at that time to this society. We were rather of the opinion that it was due chiefly to long inbreeding, and I am still of the opinion, although it has necessarily modified on account of last year's experiences, where we had fish that had come from other places which also were seized with and died from this same disease—I believe that one of the things that we ought to study more carefully is the diseases of the fish. We know very little about them.

There was a little point during Dr. Johnson's remarks that reminded me of another matter that I would like to ask about, and that is something in regard to the rainbow trout. We have felt that it was a good fish to introduce into our waters, and many years ago we propagated them to a very large extent, but after a number of years we found they did not seem to get along in the streams, and further investigation showed that in the ponds a large percentage were barren, although those barren one year might not be barren the next. The result was it seemed to be an expensive proposition to raise the fish, and they did not seem to do well in the waters of Pennsylvania, although it is one of the great trout states in the union. Therefore it is curious why they did not seem to propagate naturally. There were two or three streams in which apparently they were doing very well, and we so reported, but when we came to examine into the matter a little more closely we found that what was seemingly the young fish propagated naturally, was, as a matter of fact, fish that had been planted in there by persons who applied for those trout for other streams and put them in that particular stream; therefore we were getting various sized California trout that had been planted; but elsewhere there was no evidence that the fish increased naturally in those streams, and I would like to know if there is any one can tell me why that is.



POND No. 1—LANDLOCKED SALMON.



President: Gentlemen, we have here the President of the South Side Club, and I know we would like to hear from him on the trout question.

Permit me to introduce Mr. Slade.

Mr. Slade: The South Side Club, as some of you know who have visited it, runs a hatchery simply for the purpose of stocking its own waters. Twenty-five years ago when the late Hon. George M. Robson was secretary of the navy, we received from him a consignment of rainbow trout eggs. These were hatched, and at the age of three years were placed in our ponds which previously contained, and still contain, nothing but brook trout. We found no trouble in raising the fish, but as a sporting fish there were two objections to him: one was that the meat was not particularly good; they were rather a soft fish; and the second and chief objection from the sportman's point of view was, that it was very difficult indeed to capture them with a fly. We then tried the experiment of turning them into the salt water (our ponds communicate with the great South bay), and for a number of years we had very fair sport with those fish, they going down to the salt water and returning the following year with scales. But even then it was necessary to capture them with bait and not with a fly. Within the last few years, owing to striped bass having appeared in our river, the rainbows that we turned out have practically disappeared. We would turn out 3,000 or 4,000 fish and only catch perhaps two or three hundred.

In regard to the natural spawning of those fish, I can say very little, because our ponds being stocked every year with large fish the natural fish have a very slight opportunity for spawning, the eggs probably being eaten by the larger fish.

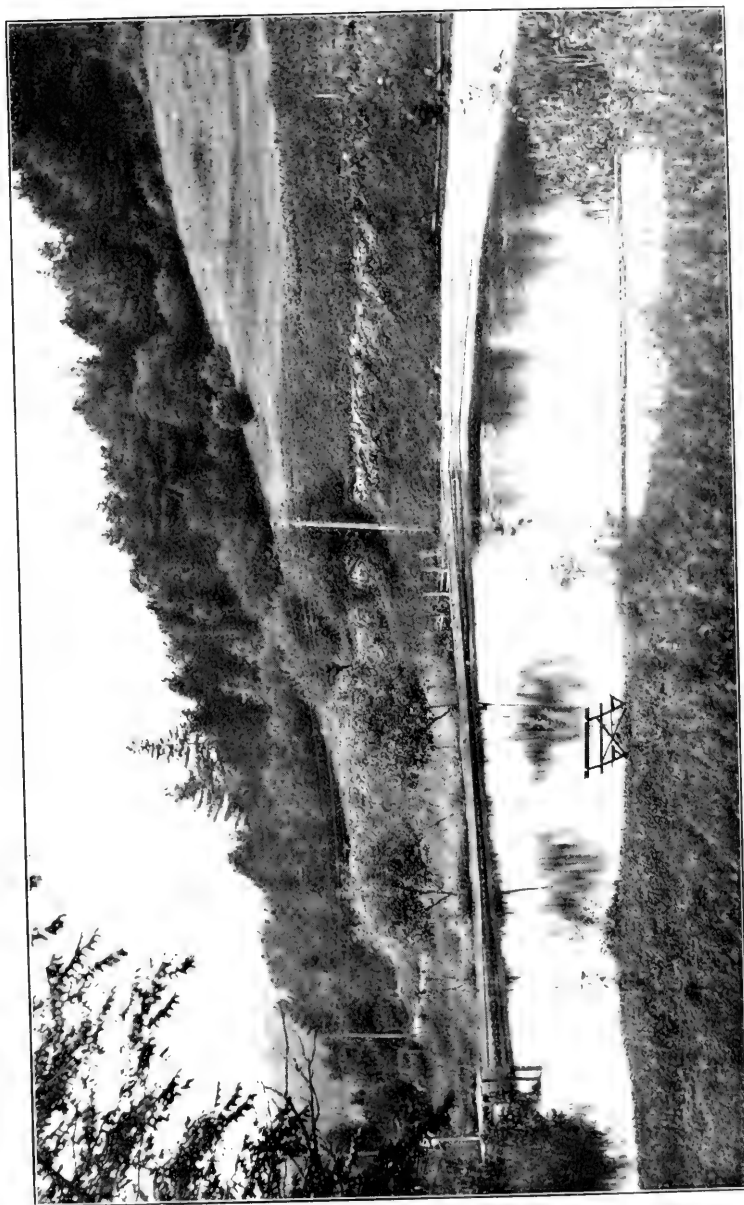
There is another subject that I would like to give a word of warning about, and that is in regard to the German brown trout. About ten or twelve years ago we received from the Cold Spring hatchery a few eggs of this fish. We hatched them and raised them to three years old, and were beginning to be quite enthusiastic about them, owing to their rapid growth, etc., but fortunately before we turned any of them out we learned from the Caledonia hatchery of the bad results of turning them out in Caledonia creek, and we therefore disposed of nearly all of the

fish, but a few of them escaped. They got into our upper brook (which by the way is never stocked with large fish, only with fry), and a few years afterward we discovered that the upper brook fishing was falling off. The natural supposition was that the brook was being poached. Our game keepers were naturally indignant at that idea and said, "The poachers in that brook are brown trout." I said, "How large have you seen them?" "Well, three or four pounds." I told them to bring me some specimens if they could, and a few days afterwards they began bringing in brown trout which they either speared or shot at night, ranging from four to five pounds in weight, and almost all of them with brook trout of six or eight inches in length inside of them. Since then we have made a strong effort to get rid of these fish. It is almost impossible to discover them in the daytime, particularly in the summer time, because they hide away under the banks, but last year and the year before we killed a great many of them on the spawning beds, some of them running as high as eight pounds in weight, this in a brook that is inhabited by brook trout which will run not over a quarter of a pound in weight. Within the last two weeks I have discovered that some of those fish are still in our preserves. The symptoms in our preserves are different from those described by the gentleman from New York—the trout simply disappear—when, as occurred about three weeks ago, a brown trout weighing fifteen pounds was shot in a preserve that contained about 5,000 two-year-old fish; a gentleman made a calculation, assuming that that fish was ten years old, and that he ate only one fish a day, that he would have consumed 3,650 fish in ten years time, which would account for a very large mortality in that particular preserve. (Laughter.) I will not take up your time longer, but I feel that everything that was said the other day in regard to the German carp could be said with greater truth in regard to the German brown trout. (Applause.)

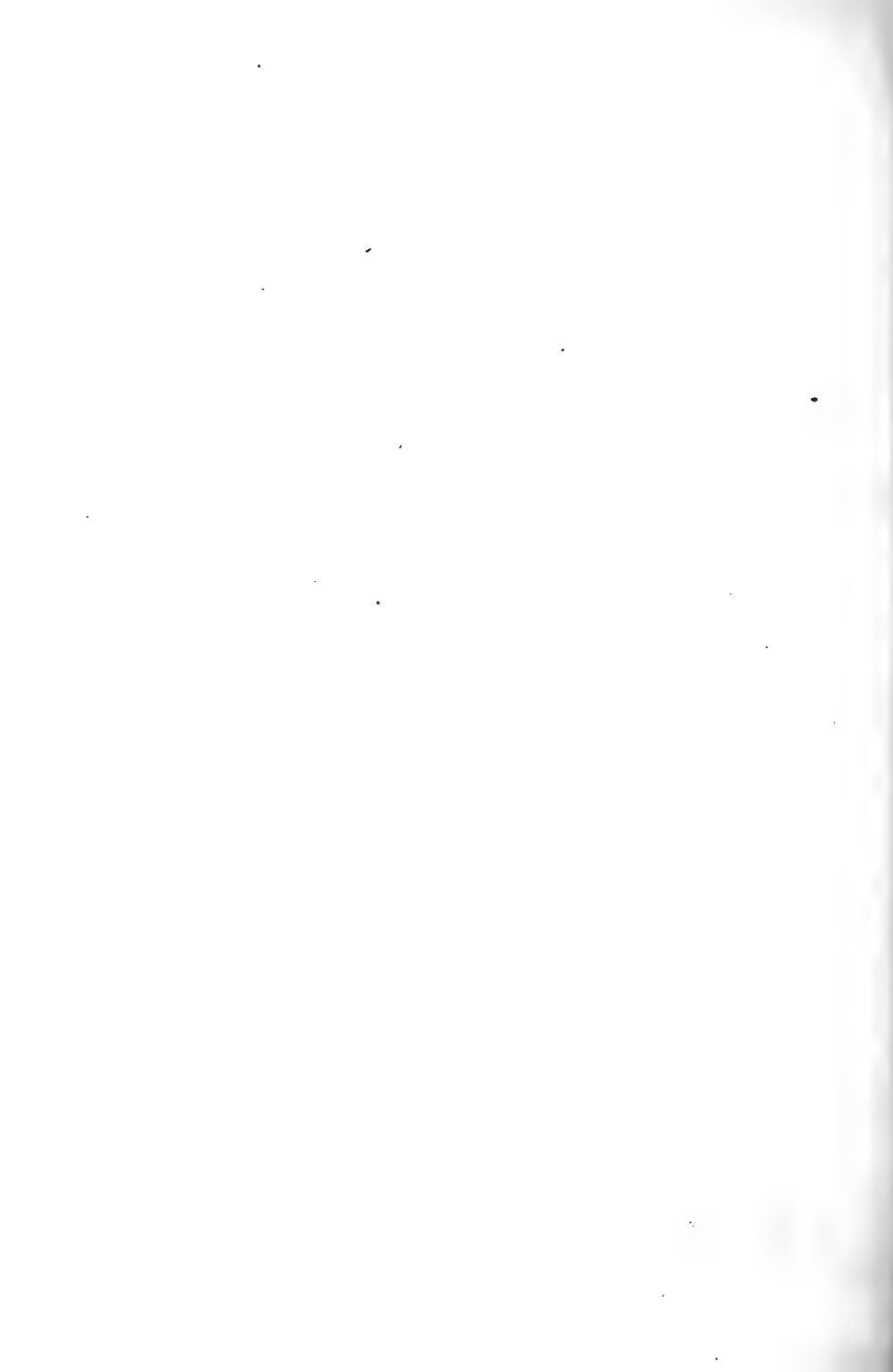


POND No. 2—NATIVE TROUT.





POND No. 3—GRAYLING.



THE RECENT HATCHING OF STRIPED BASS AND POSSIBILITIES WITH OTHER COMMERCIAL SPECIES.

BY S. G. WORTH.

The second season of operations in striped bass hatching by the Bureau of Fisheries was concluded at Weldon, N. C., on May 31st, just passed. From the experimental basis of the preceding year, the equipment was enlarged to an extent to permit operations of some proportions, but constructed and arranged along temporary lines as before, canvas tents serving as covering for hatchery and employes' quarters. In place of thirty hatching jars, used the year before, 120 were put in, and all other preparations were made in about the same fourfold proportion.

A striking and rather embarrassing feature was the occurrence of eggs in gluts, eighty-three and one-half per cent of the season's collections being obtained on one date. Of 13,683,000 eggs gathered, 11,427,000 were brought in on May 6, enough to overstock the hatchery, to the extent of seven jars, allowing 90,000 to the jar. All the eggs are good. I was aware that the jar equipment was under the mark, but as there was much other equipment equally necessary and consuming funds, I depended on seventy Seth Green Boxes, made on the grounds, for the receipt of any eggs which the jars would not accommodate. It was only because of a bad season of fishing that the 120-jar equipment proved to be ample for the occasion.

An actual account of eight fluid ounces of eggs revealed the presence of 35,148 in a United States standard liquid quart. The hundreds being dropped, 35,000 was adopted as the unit of measure, and a measure stick was made with five gradations to the inch, representing fifths of a quart or 7,000 eggs. The lines on a shad measure stick also denote 7,000 eggs, but they stand for fourths of a quart, fourths of 28,000. The striped bass scale, if divided into fourths, would lead to endless fractions. Last year's computations of eggs and fry were based on an estimated quantity of 25,000 to the quart and need to be

raised forty per cent for accuracy, it being then believed that rockfish eggs were larger than shad eggs and fewer per quart.

In a period of twenty-three days, from May 2 to 24, and with the river temperature ranging between 60 and 70 degrees, Fahr., twenty ripe fish were stripped, the eggs from every one of them being good. The wide difference in the sizes of the spawning individuals is noteworthy. The largest of seventy and the smallest of three pounds weight, the average of nineteen of them was twenty-six pounds; five, ranging from forty to seventy, averaging fifty-five pounds; four, from twenty-three to thirty-five, averaging twenty-seven; seven, from ten to eighteen, averaging fourteen; three, from three to seven, averaging five pounds. Over eighty per cent were above ten pounds weight.

The smallest yield of eggs was 14,000, from a three-pound fish; the largest 3,220,000, from a fifty-pounder, while the average from the twenty fish was 684,000. On May 6, four females, stripped at one spawn-taking camp, with weights at fifty, forty, seventy and fifty pounds, severally, yielded eggs as follows: One fifty-pounder 3,220,000, and three others, whose product could not be kept separate, an aggregate of 6,440,000, the three averaging 2,150,000, while the average of the four was 2,414,000 eggs. After water-hardening there were ninety-two liquid quarts of eggs as the products of the fifty-pounder, and eighty-one seven-quart spawn-taking pans were overcrowded with the eggs from the four individuals. When sixty-eight of these fifteen-inch-diameter pans had received their quota of eggs from the first three fish, there was not room on the eight by sixteen scow to permit proper watering and their aggregate weight, of 1,000 pounds, with that of four spawn takers, set the newly made boat so deep down in the water that she commenced sinking and would have gone down but for five hours' constant, hard bailing by our cook. The transfer of the eggs to the hatchery by hand was slow. The distance was about 700 yards, and the lowland clay was as slick as glass from an all night rain and the night dark.

On this night when fishermen offered the fourth spawner, twenty-nine pans of eggs taken from the first fish were hastily put into seven Seth Green boxes astern of the scow, to make room for the new supply. As time advanced the eggs swelled up

in the boxes, making a measured volume of twenty-three gallons (from the specially designated fifty-pound fish) while the aggregate water capacity of the boxes was only thirty-eight gallons. Left in the river over night, they died of suffocation, of course. The party of operatives was more quickly and hopelessly fatigued in consequence of the rain, which soaked our clothing. It was not intended when the eggs were put overboard to leave them in the river over night, nor did I for a single moment realize what a great quantity the seven boxes had received till the following day when the eggs were measured. In future operations, to avoid all risk from such gluts, sure to occur and with no means of foreknowing at what camp, I shall have one or two pans of eggs placed in the live boxes soon after they are taken and without waiting to fully water-harden them in the pans, as practiced heretofore. It is only by the adoption of such means that the usual detail of two spawn takers can cope with the egg gluts. Eggs collected at the more distant camps were invariably held over night in the live boxes, but in more reasonable numbers, and successfully. In the case of loss, just recited, the taking of 9,660,000 eggs in the space of two hours by four men was, indeed, overwhelming.

Nine spawn-taking camps were established along the river, covering a distance of nearly twenty miles, two men to each, the crews living on the river shores and cooking for themselves.

There were 10,463,000 eggs put in circulation in hatching jars, with the result that not a ticket representing the contents of a jar was crossed off in consequence of failure of the eggs to hatch, the number of fry produced being 7,219,000, or sixty-nine per cent, thus affording sure evidence that the eggs are capable of undergoing satisfactory manipulation.

A third season of operations at Weldon will demonstrate to others that which I realize to be the fact, viz: that all obstacles to successful collecting and hatching of eggs on the Roanoke river have been met and overcome, and that confidence will attend efforts towards expansion there and elsewhere.

It was found impracticable to hold fry in collector-aquaria with the metal screens used in current shad operations, and cheese cloth bags on wire frames were reverted to. On May 8, fully three-fourths of the fry (4,450,000), bursting from the

eggs in the forty-hour period, were killed on the metal screens, within two hours of hatching. There was no remedy applicable. I immediately set to work, however, and had cheese cloth strainers made, and on using them solved to entire satisfaction the problem of aquaria strainers.

The fry display an inordinate propensity to escape. In feathering them off of the metal screens the sacs of great numbers were ruptured, flooding the aquaria water surfaces with oil. While the newly taken and unfertilized eggs are of a decided and highly attractive green color, the oil from the fry sacs is amber. During the heavy mortality of May 8, there were myriads of the buoyant oil globules afloat from the minutest size up to nearly one inch in diameter.

From the very small size of the four-hour-old fry, about three-sixteenths of an inch long, which I here exhibit, it is obvious that it would require the bursting of many sacs to afford the pronounced effect in oil globules described. The four-day-old specimens, here displayed, about one-fourth inch long, represent the approximate size of 3,698,000 fry deposited in the Roanoke river, that number being the season's output. The four-weeks-old specimens, about one-half inch long, were reared in a crudely constructed pool near the hatchery door. Their fins are easily discernible, and when they were being introduced into the vial, the stripes down their sides could be seen. I do not think that partial rearing in ponds could be other than successful, as the water in the temporary pool at Weldon was of very high temperature and almost stagnant.

The run of adult fish at Weldon, from unknown causes, was the smallest ever known. J. E. Moody, in twenty-one seasons, during some of which he did not fish the spring through, averaged 847 fish with sales \$298.38, but got this year only 227 fish which sold for \$82.40, all other "drag-netters" faring as bad, and most of them worse.

It was learned on what was believed to be trustworthy evidence, that striped bass are annually caught in Roanoke river on trot lines in the vicinity of Hamilton, in commercial quantities, two men being able to take 200 pounds a day, or about 1,000 a week. Hooks are baited with fresh cut herring (alewife). Up at Weldon their capture with a hook is an extremely rare occurrence.

From information gathered at Weldon I entertain the opinion that the sturgeon has habitually sought the falls of the Roanoke river for casting its eggs in the identical swift waters in which the striped bass reproduce. This choice of partially cataract waters may be known to others but it was new to me. When in 1887 I spent three weeks at Delaware City, Delaware, looking for spawning sturgeon for the United States Fish Commission, I doubtless should have been among the foothills of Pennsylvania, 150 miles further up stream. The falls at Weldon are so swift that a boat cannot be successfully paddled against the current. The boat has to be shoved with a pole. There is a ten-foot fall to the mile.

Apparently, river sturgeon spawn in head waters in rapids.

Last fall and winter I made investigations for the Bureau of Fisheries, of the spawning habits of commercial fishes at Beaufort, N. C., and at a minimum cost acquired a knowledge of the jumping mullet and Spanish mackerel, which I believe will bring these fish under artificial hatching methods almost immediately. The former, as a pickled fish, is so highly esteemed in the North Carolina region of abundance, that it is destined to find a more widely extended market. It is almost beyond doubt superior to salt mackerel. In September, just prior to its spawning, it is in highest condition as food. I anticipate, with confidence, that I shall gather and hatch its eggs in October of this year. I am nearly as positive that I can gather Spanish mackerel eggs at the first attempt, when a letup in other duties permits a trial. A partial knowledge of the spawning habits and eggs of this fish has been acquired, and it only needs that a supply of eggs in volume be found to permit artificial propagation to gain a footing. I believe that I have discovered the locality of regular and abundant egg supply. The spawning habits of the jumping mullet have remained unknown, in the face of systematic efforts to disclose them, until last November, when I found females in all stages from full roe to empty downrunners. I was absent in October when the main school appeared and spawned.

While investigating at Beaufort, I also became almost certainly convinced that the Menhaden spawns in the vicinity of Beaufort, in the month of November. I handled a number of

ripe males and gathered other evidence supporting the belief that they spawn at sea but a few miles off shore and some probably in inside waters, such as Newport river.

DISCUSSION OF MR. WORTH'S PAPER.

Mr. Titcomb: I want to ask Mr. Worth whether it makes any difference about laying that rockfish on its left side or right side, except for the convenience of the person stripping?

Mr. Worth: With a left-handed man it is better to use the right hand.

Mr. Titcomb: About the rockfish in that part of the river where they take the hook and line are some of those fish ripe when caught?

Mr. Worth: I could not answer that, but I believe not. It is forty or fifty miles below the spawning ground.

Q. Do you know from your experience whether the rockfish will take the hook and line when they are ripe?

A. I do not from my experience, but from observation at Weldon, and what the fishermen say, I believe they will not take the hook and line when they are in a spawning state. Apparently the taking of the hook below Weldon is after the occurrence of the spawning above when they drop down the river.

Mr. Titcomb: I think that is a point that is well worth observing in the future and as closely as possible. We have been trying the rockfish at Port Deposit on the Susquehanna. It is there where they take them with hook and line. I have an impression that the fish as a rule do not ripen until they are above there, although ripe females have been taken in nets below Port Deposit.

Mr. Worth: That is true.

Mr. Titcomb: I want to say to the members of the society that this rock-fish question is a very important one and we want to get hold of them wherever we can. Now if any of you know where the rockfish is caught in abundance and in a ripe spawn-

ing condition, the U. S. Bureau of Fisheries would like to know it.

The same way with the sturgeon for that matter. We want to propagate those fish where they are spawning in sufficient abundance to make it worth while to do so, anywhere in the country.

Mr. Stranahan: I would like to ask Mr. Worth what the prospects are of hatching the jumping mullet in large quantities?

Mr. Worth: I think there is an unusually good prospect. At Beaufort last fall they had a storm about the 8th of October which caused the large fish to scatter from there, and they caught very few there, but ordinarily they catch large fish in quantity. They always catch large spawning fish in quantity a few miles below in the adjoining counties. From specimens which I saw in November of last year, after the October spawning had occurred, I am perfectly confident that the fish spawned at Beaufort, and their yield of eggs per fish must be enormous from the small size of them and the great quantity that is in the individual. I saw dead specimens with the eggs all over their bodies; it looked as if a person with damp hands had put his hands in a barrel of old fashioned brown sugar. They were sticking all over the fish from the nose to the end of the tail; and the oldest and most reliable fisherman at Cape Lookout and on Shackleford's banks where my observations were made, confirmed the statement that in the cool sharp weather in the fall it had been a common thing there all their lives to see the body of the water on the rip-rap shoals covered with the great quantity of eggs that those fish had ejected. I could say more on this subject but I suppose I have answered the question.

Mr. Stranahan: One more question: is it not a fact that the jumping mullet for the extreme south is the most important of all fishes?

Mr. Worth: The jumping mullet is only just coming to be thoroughly appreciated by the better class of people. In the south he has been called a "nigger" fish, and for that reason a great many southern people won't eat it.

Now should not Mr. Titcomb include that fish with the rock-fish and with the sturgeon? Should not that work be pushed? Is not the jumping mullet disappearing rapidly?

Mr. Titcomb: I will accept the amendment.

Mr. Worth: I have been detailed by the commissioner to make investigation and am on the grounds at Beaufort in regard to taking a second year's observation, and I am confident I will get eggs in great quantities.

PROGRESS OF EXPERIMENTS IN SPONGE CULTURE.

BY H. F. MOORE.

From the Levant and the north coast of Africa, from the Bahamas and the Islands of the Caribbean, from our own waters of Florida, in fact from all the world's sponge fisheries, there comes complaint of a yearly decreasing supply of sponges, at the same time that the principal markets of the world reflect an increasing demand. The direct and immediate effect of the operation of these two factors is to increase the price; the secondary effects are to stimulate endeavor in the fisheries on the one hand and, on the other, to withdraw from the sponge market those arts which are able to utilize a cheap and inferior substitute.

It will be readily seen what must be the inevitable result of an increase in the effort made to find and take a species which even under the less strenuous endeavor of former years was unequal in productiveness to the demand upon it. Unless new and extensive ground be discovered, the increase in zeal and numbers of the sponge fishermen can only result in the more speedy exhaustion of the beds already known and to some extent exploited. With the increase in value, there goes *pari passu* not only a more careful gleaning from the beds of the larger and more desirable sizes, but a tendency to take all and any of whatever size found and at the same time to adopt methods of capture which are in themselves injurious.

In the Mediterranean, the chief cause attributed for the decrease in the yield of sponges is the use of artificial diving appliances in substitution for the primitive methods of fishing in vogue until within the last thirty years. It is stated that not only are many young sponges killed by the mailed boots of the divers but that the sponge bottoms are so thoroughly scoured of breeding sponges that few are left to reseed the depleted beds. Whatever may be the merits of the disputes which have arisen over the matter, the fact remains that the product of the Mediterranean sponge beds has seriously decreased, the yield of the

island of Cyprus for instance being in 1898 but thirty-five per cent of the product in 1899. Italy, Tunis, Samos, Crete and Cyprus have all taken measures to prohibit the use of diving apparatus, and it is thought that before long, if they have not already done so, Turkey and Egypt will follow the example of their neighbors.

On the western side of the Atlantic we have had no opportunity to judge of the effects of diving apparatus. Florida and, it is the impression of the writer, the Bahamas also, have anticipated its introduction by enacting prohibitory laws. In Florida, Cuba and the Bahamas practically but one method of sponging is employed, the sponges being detached from the bottom by means of three-tined hooks on poles whose lengths are graduated to the depth of the water. In using these in deep water two men are necessary, one examining the bottom through a water glass, a glass bottomed bucket, and detaching the sponges when found and the other sculling the boat. In shallow water but one man is employed in a boat. It might be assumed that this somewhat primitive method would not prove especially destructive but the sponges are decreasing in abundance nevertheless. The chief complaint against the spongers of Florida, and of the Bahamas and Cuba as well, is that they catch an undue quantity of small and relatively valueless individuals. An act of legislature of Florida, approved May 30, 1901, provides that "whoever gathers sponges less than four inches in diameter, or whoever catches, sells, or buys, or offers for sale, sponges of less diameter than the aforesaid, shall be punished for each offense by a fine not exceeding five hundred dollars," etc. This law, however, is a dead letter and at every sponge sale sponges of less than the legal diameter are to be seen in the cargoes.

The buyers would prefer not to buy these small sponges, but the rivalry to purchase is so keen that they take them to secure the more desirable sizes sold in the same lots. The loss arising from this abuse will be appreciated when it is stated that the experiments of the Bureau of Fisheries have shown that in two years a sponge may grow from a diameter of three inches to one of six inches, increasing eight fold in weight and at least twenty-five fold in value. One dealer in a single season bought between sixty and eighty thousand sponges of the approximate diameter

of four inches and probably the total catch of sponges of that size is not far from 300,000 per year. In addition to this direct financial loss to the spongers there is also the loss of the breeding potentiality of so many individuals removed from the beds before reaching full reproductive activity.

Even should the laws be strictly enforced, however, and this waste be eliminated, it is not possible for the natural beds to sustain the demand made upon them. It is true that the sponge can never be commercially exterminated owing to the physical conditions under which it exists. The almost perennial turbidity of the water on many of the grounds makes it impossible to sponge with methods now in use except at most infrequent intervals, and during the periods of enforced rest the grounds recuperate and the sponges multiply. This, however, does not satisfy the conditions of the case, as it simply perpetuates the supply by restricting it. What is needed is an actual permanent increase in production to keep pace with a growing demand and in a measure to stimulate it.

To those who have studied the matter, it is evident that this condition can be met only by some method of artificial culture analogous in general to the methods which have in many places re-established and maintained the supply of oysters.

The question of sponge culture is not a new one. A number of theoretical considerations have been offered and several attempts at a practical solution have been made. It has been proposed to multiply and improve the supply of sponges by growing them from cuttings and from the egg and by grafting superior varieties upon those less desirable commercially. It does not appear that there is much of value in the last suggestion, which is based upon an imperfect analogy between sponges and the higher plants. If cut surfaces of two closely related varieties of sponges be brought into apposition they speedily fuse and heal. In the case of plants, each member to the graft exerts more or less influence upon the resulting plant unit, which may perpetuate a particular hardiness or habit of the stock, for instance, with a special fruit quality derived from the scion or bud. In sponges, however, each part of the graft will continue to grow, very much as if it had remained independent. In other words, nothing can be done by grafting which cannot be done

with less trouble by means of independent cuttings. In each case the result depends to some extent upon the character of the original sponge from which the cutting is derived, but apparently to a greater degree upon the nature of the environment to which the cutting is exposed during its subsequent growth.

It is doubtful if the breeding of sponges from the egg will become of much value as a general method, as it is likely to prove altogether too costly, complex and difficult to be utilized by the practical sponge grower. To the scientific experimenter and the worker in the laboratory, it is comparatively easy to raise a few hundred or a few thousand sponge larvae beyond the stage of fixation, but the difficulty will come in carrying the young sponges to further development in vastly increased numbers under conditions which will yield a financial profit. It is possible, however, that a superior variety of sponges may be developed by selective breeding from the egg and that the individuals so produced may be used to perpetuate the desirable qualities by cuttings. To the writer this seems to be the chief practical utility of sexual sponge breeding, but while this is merely a possibility, there is on the other hand the demonstrated fact that the same end may be at least in a measure produced by sponge cuttings grown under the influence of a selected environment.

The method of propagation by cuttings is the one which has to the present time received the attention of those who have attempted to solve in a practical way the problems of sponge culture. Prior to the work begun by the Bureau of Fisheries, experiments had been carried on in the Adriatic and on the Florida coast near Key West and in Biscayne Bay. In the Adriatic the work was begun in 1863 and continued until 1872 when it was abandoned owing to the antagonism of the inhabitants of the neighborhood, who destroyed and plundered the experimental plant. The experiment was the outcome of a suggestion by Prof. O. Schmidt and was begun under the joint auspices of the Austrian Government and certain merchants of Trieste. In general the method of procedure was to cut the sponges into pieces of about one inch cube, perforate them with a stiletto or trepan according to circumstances and fasten them by means of pegs to stones, boards and more or less simple structures designed for their support. These cuttings grew to two-thirds

times their original bulk in the first year and it required seven years to raise completely matured and merchantable sponges. The chief difficulty, aside from the hostility of the inhabitants, appears to have arisen from the destruction of the supports by teredos and other boring organisms. It was found, too, that direct sunlight was inimical to the sponges and some the complexities of the supports arose from the effort to shelter the cuttings from the direct rays of the sun. So far as is known no practical use has been made of the methods developed by these long continued experiments.

Concerning the first attempts to raise sponges artificially near Key West, we have very insufficient data. Sometime in the late seventies or early eighties, 216 cuttings were planted in a depth of about two and one-half feet of water, being fastened to the bottom by means of wires or sticks running through them. The cuttings were originally about two and one-half inches long and four specimens sent to the National Museum showed that as a result of six months growth they had increased to four-sixth times their original bulk. This experiment was never pushed to a conclusion and the fate of the cuttings other than the four mentioned above is unknown. About twenty years later (1898 circa) several thousand cuttings were planted at Sugar Loaf Key by Dr. J. V. Harris of Key West. They were attached to galvanized wire laid on the bottom in from two to four feet of water. The mortality in these cuttings was very high and the wire soon corroded and broke in pieces. From time to time parts of this wire with a few sponges attached have been picked up. Growth appears to have been slow or, after a time, entirely arrested and the largest specimens seen by the writer have been under four inches in diameter with an age of three to five years. Exact data as to the age of any given specimen is not obtainable.

In January 1901, the Bureau of Fisheries began a series of experiments under the direction of the writer, at Sugar Loaf Key and at several places in Biscayne Bay where several thousand of cuttings were planted under a variety of environmental conditions and by a number of different methods. It was found, as all previous experimenters had found, that the commercial sponges are all more or less hardy and that they are but little

injured by reasonable exposure to the air. The writer has kept specimens of the sheepswool sponge, out of water, during the winter months for a period of seventy-two hours without material impairment of the vitality of the cuttings made from them, the only precaution observed being to keep the specimens in moist hay in a shady place.

The cuttings are easily made with a large sharp knife. The sponge of the markets is merely the supporting skeleton and in life most of its interstices are filled with a fleshy pulp, containing cavernous canals communicating with the exterior by means of pores. The surface is covered with a dark, almost black skin and the fresh sponge looks and cuts not unlike a beef's liver. The chief problem confronting the experimenter was to find some ready means of attaching the cuttings to a durable support, capable of resisting the chemical action of sea water and the ravages of the teredo and other animals having similar destructive habits and which at the same time is without injurious effect upon the sponges.

During the first season the cuttings were attached to stakes and rectangular frames laid on the bottom, vertical stakes, pieces of coral rock, and copper wires stretched on the bottom or festooned between stakes. Some of the cuttings were threaded on the copper supporting wires and others were fastened to them by means of shorter lengths of lighter wire, with the expectation that the sponge would eventually encompass its support.

About six weeks after the plants were made, it was found that ninety-five per cent had healed and were living under apparently healthy conditions but by November 1901, seven or eight months later, most of them had died and some of the wires had been stolen. It was evident that the choice of materials and localities had been unfortunate. The chemical action of the sea water on the copper resulted in the production of copper salts injurious to the sponges and even the cuttings which remained in situ were dead around the wire. The cuttings placed on the bottom had become covered with silt and vegetable growths and practically all of them were either killed or lost.

During the following winter of 1901-02, advantage was taken of the experience gained from the failure of the previous year and in addition to Biscayne Bay and Sugar Loaf Key, Anclote

Key was selected for further experiment. Instead of using naked copper wires, various types of insulation were tried, other metals, including lead and heavily galvanized iron, and various cordage materials were experimented with, moulded forms of terra cotta, plaster and cement were used instead of the rocks and stakes laid on the bottom, and better judgment was used in selecting localities for planting. It was found that places but a few hundred yards apart differed markedly in their adaptation to purposes of sponge culture as was shown at Sugar Loaf Key by the progress of cuttings planted on opposite sides of a small point of land. Currents of at least moderate strength are important desiderata, supplying the sponges with the abundant food supply essential for rapid growth. Another fact established was the advantage of raising the sponges above the bottom. Not only do they grow more rapidly, but they are superior in shape, and the proportion of survivals is far greater than when they are placed on the bottom. They are free to grow in all directions and assume a spheroidal shape, they are bathed on all sides in food-laden water, the stronger currents above the bottom carry more food within their reach and finally they are less liable to suffocation and overgrowth by silt and vegetation.

It was also found that the cuttings were more or less injured in being threaded on the long insulated supporting wires and that when the pieces were merely bound against the wire they were sometimes so slow in growing around it as to jeopardize their attachment before the corrosion of the binding wire. To obviate these difficulties, the expedient was adopted of slitting the cutting, placing the two legs of the slit astride of the supporting wire and binding the severed faces in close apposition by means of aluminum wires or rubber bands. The slit speedily heals and the cutting becomes organically intact around the wire. Aluminum wire was adopted for binding purposes because its salts in sea water are neither rapidly produced nor injurious to the sponge. The more or less expensive insulations composed of various patented compounds of rubber, etc., which have been found to possess superior properties for electrical purposes soon developed their worthlessness for sponge culture, the insulation being affected by the salt water and stripping from the wires. Underwriters insulation, so-called, a cheap covering of cotton

and white lead proved to be the most durable, and, to anticipate somewhat in the account, lasted for about two years. In the case of this material, both wire and covering were very light and subsequent experience has shown that a heavier wire is much more durable. Asbestos cord was found to be practically indestructible chemically, but when wet the fibres become so slippery and loosely laid that the tensile strength is greatly reduced. This difficulty was overcome by treating the asbestos with rubber solutions, white lead, a mixture of paraffin and asphaltum, and other waterproofing and cementing substances. These treatments very greatly increase the strength of the cord, but the rubber treatment is somewhat expensive and the asphaltum for some reason causes undue abrasion of the sponge. Lead wire possesses the important quality of permitting a true organic attachment of the sponge which thereby clings to its support quite independently of artificial attachments, but its tensile strength is so low that it is unable to support its own weight to say nothing of the weight of the sponges and the pressures exerted by waves and currents.

The terra cotta and cement blocks used on the bottom were found unsatisfactory for a number of reasons. They were cap-sized by the waves in many cases and the cuttings buried in the mud and even when they remained upright silt and vegetable matter in a great many cases destroyed or injured the cutting. The results enumerated, the very evident advantages of raising the sponges above the bottom, and the mechanical advantages of planting and raising the sponges on wires all operated to discourage further experiment on these lines.

During the winter of 1902-03 certain changes, founded upon the experiences of the previous winter, were made in the character of the materials used through the general method of making and fixing the cuttings was the same. To get the virtues of lead its chemically inert and innocuous qualities, and at the same time to eliminate its vice of tensile weakness, the device was hit upon of using ordinary tarred marline encased in lead of a thickness of about one thirty-second of an inch. The marline core furnished the necessary strength, and the lead casing, besides protecting the cordage to some extent from decay, furnished the basis for an organic attachment of the sponges, a desideratum of

some weight. If the sponge be loose on the wire, its rotation causes an enlargement of the perforation through which the wire passes and there is also a waste of growth energy in the necessity for the readjustment of the canal system. If a sponge be inverted, there is tendency to the closure of the original oscula and the formation of others upon the new upper surface and if the processes of inversion be frequently repeated, as when the sponge is free to rotate, growth is retarded by the necessity for repeated readjustment.

When lead-covered marline is used, within a week after they are planted, the cuttings have attached themselves and become permanently oriented with respect to their supports. At the time of writing, lead covered marline has been in use for nineteen months and is in a good state of preservation. Several lines have broken near the stakes to which they were immovably attached, but a more flexible attachment has prevented the repeated flexure of the lead under the movement of the waves and since its adoption no trouble has been experienced. Asbestos coated with paraffin and asphaltum and encased in lead has been used in the same manner and with practically the same results.

Several forms of lead-covered insulated wires have been employed, but the ordinary commercial sorts have been unsatisfactory, being either too heavy, or, if sufficiently light and cheap, lacking in durability. A specially made wire with underwriters insulation encased in lead appears satisfactory after several months of trial, but it is somewhat more expensive than the lead-covered marline. In this material, also, a rigid attachment to the stakes causes the lead covering to break near the supports owing to the repeated flexure of the wire as it sways with the waves. The attachment is now made by means of a stirrup-shaped bridle of copper and wood. This was a makeshift device and while it answers the purpose, cheaper and more durable arrangements will be adopted in the future.

The experiments have not reached a definitive stage and some of the mechanical problems have not yet been solved. It is not yet even determined if a sufficiently large proportion of the cuttings will grow to a marketable size to warrant the embarkation of capital upon the venture of sponge growing.

In these experiments as in their predecessors it has been found

that certain cuttings grow but little or not at all even though they live for several years. Why this is so has not been determined but it is probable that some parts of some sponges have reached a stage where they are incapable of further extensive growth and when a cutting is taken from such parts it undergoes no increase in size. Whether there is a limit to the size to which a sponge will grow under natural conditions, and if there is a limit what imposes it is not known. If it should be the result of the disparity, growing with the diameter, between the surface area and the volume, then the inhibition would not apply to the cuttings until they had reached at least the approximate size of the parents. If on the other hand there be some inherent or inherited limit, say to the number of cell generations from the egg, then the excision of pieces from the sponge would not change this and the cuttings would not grow in the aggregate to a weight beyond that of the original sponge had it remained intact and unmolested. If this latter suggestion should prove correct, it would be a serious though not fatal objection to the method of raising sponges from cuttings. In the results so far obtained there is no reason to anticipate failure or partial failure from the cause, though during the present summer the mortality among the larger sponges has been somewhat alarming.

On the whole, the progress of the experiments and their future are promising. Growth while showing some irregularities in rate has been fairly rapid. Cuttings originally measuring about two inches by one inch have in eighteen months developed into spheroids four inches in diameter. These are larger and heavier than many of the natural sponges put on the markets, but the price brought by sponges of this size is so low that it would not be profitable to raise them. The largest sponges which have been grown were from cuttings of the size mentioned above and in thirty months measured nearly six inches in their longest diameter. This, however, was above the average.

Concerning the proportion of survivals, an important consideration, nothing very definite can be said. The exigencies of experimental work have made it necessary to frequently change the conditions under which the sponges were growing, the original wires and other supports were replaced in some cases two or three times, mishaps occurring during the absence of the ex-

perimeter were not corrected for several months and various other difficulties were encountered which would now be foreseen and forestalled. Those which have suffered fewest vicissitudes showed a mortality of five per cent after eighteen months and ten to twelve per cent after thirty months. Though most of the lines showed a mortality far in excess of this, it is believed that with the experience now available and under the constant care which they should receive the mortality would not exceed fifteen per cent in three years and even this could undoubtedly be reduced. The quality of the artificially grown sponges depends largely upon the environment under which they are grown, but in all cases it is superior to that of the natural sponges grown in the same locality. The texture is closer throughout, the surface is more closely felted, the shape is superior to that of the average natural sponge and there are no shells or rocks to be removed or clipping necessary to prepare the sponges for the market. One of the chief merits of the artificially grown sponge is that it has no "root" so-called. The root is that portion of the sponge which is attached. When it is torn loose, it leaves a raw surface which is the first part to wear out in use. In the artificially grown sponge, the whole surface is felted and equally durable, and ordinarily the orifice through which the wires pass will escape the closest examination. The large specimen shown passed through many vicissitudes and the large size of the hole is due to the fact that it was loose on the wire and its rotation wore away the tissues.

The sponges appear to be of better quality, so far as the character of the surface is concerned, when harvested in winter. Most of the growth takes place in the summer and there is then a preponderance in the production of the radial fibres, but during periods of slower growth, the production of tangential fibres fills in and felts the surface.

Winter or late autumn and early spring are also the seasons for planting, as the cuttings can then be handled with less liability to injury.

In conclusion, the statement should be emphasized that the experiments are not yet conclusive, that the Bureau of Fisheries is not yet prepared to recommend sponge culture as a practical industry and that the loss of some of the larger specimens during

the present summer may presage difficulties which it will require much experimentation to overcome. On the whole, however, the results are regarded as promising and that this is not the opinion of the Bureau of Fisheries alone is indicated by the fact that a firm of wide experience in the sponge business has recently undertaken the experiment on a commercial scale, a venture requiring not a little business courage and enterprise.

DISCUSSION OF MR. MOORE'S PAPER.

Dr. Smith: This may not be such a burning question as the carp issue, but I think the whole civilized world is interested in bath and toilet sponges. Dr. Moore has been engaged in experimenting at a number of points on the Florida coast in the growing of sponges from cuttings, this appearing to be the only feasible way of increasing the sponge supply artificially. The sponge industry of Florida and the Mediterranean is reported to be in a very unfortunate condition, owing to an alarming decrease in the supply. The countries most interested have inaugurated legislation prohibiting the further use of diving apparatus for collecting sponges, it being held, and probably truthfully, that the heavy shoes of the divers crush the small sponges while the divers themselves are able to clean up the bottom so effectually that there is no seed left.

Dr. Moore has worked under very great disadvantages, and is not yet ready to recommend to the sponge world a thoroughly practicable method of sponge culture, but I can say for him that he has got so far along in his work that the outlook is very promising.

The method he is now pursuing is to take sponges as they come out of the water, which look very different from the sponges we use in our houses, and cut these sponges into small pieces, which are in turn incised and put on wires which run through the incised places, these wires being strung between sticks, so that the sponges attached thereto are beneath the surface at all stages of the tide.

I will pass this sponge around because many gentlemen have never seen a sponge as it comes out of the water. The skeleton which we use in our houses is filled with a pulpy mass which is

the living part of the sponge. Sponges can be kept out of the water for a considerable length of time without injury—as long as seventy-two hours I believe, provided they are moist. The clippings which Dr. Moore has used are like these. (Indicating.)

One important point about this method is that sponges which because of their quality or irregular shape have no value in the markets can be used for planting purposes.

It is probable that under favorable conditions sponges can be successfully grown for market within eighteen months, and certainly sponges as large as it would be necessary for the sponge culturists to grow can be put on the market in thirty months, perhaps even twenty-four months.

This is a sponge taken from the wild ground in the vicinity of some of Dr. Moore's experiments. I call attention to the quality of this sponge and ask you to compare it with some that have been artificially grown.

This is an artificially grown specimen supposed to be twenty-one months old. It was dead when taken from the wire and therefore its exact age cannot be determined. This is as fine a sponge as is produced anywhere in the world, and it has a very decided advantage over the wild sponge in that its texture is firmer; it contains no coralline rock, worm tubes or other foreign matters which are ordinarily found in wild sponges, and it has no base, where, as you know, the ordinary commercial sponge rots, and as a result the sponge has a comparatively short period of usefulness.

This is another sponge recently brought from his experimental farm (exhibiting sponge), and, although it does not represent the largest size that he has grown from these little cuttings, still it is a fair-sized sample. These sponges as you will see, are of admirable quality for toilet purposes. This specimen which I show you is supposed to be about thirty months old, and it too was dead when it came from the wire. (Applause.)

FISHERY REMINISCENCES IN SOUTH AMERICA.

BY JOHN W. TITCOMB.

Owing to failure in getting lantern to illustrate this paper, Mr. Titcomb will present it at the next meeting, in July, 1905, and it will then be published in the Proceedings.

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Wentworth, Nathaniel, *Hudson Centre, N. H.*

Weed, W. R., *Potsdam, N. Y.*

Wetherbee, W. C., *Port Henry, N. Y.*

Wheeler, Charles Stetson, *Hobart Bldg., San Francisco, Cal.*

Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*

White, R. Tyson, *320 Bridge Street, Brooklyn, N. Y.*

- Whitaker, Hon. Andrew R., *Phoenixville, Pa.*
 Wilbur, H. O., *235 Third Street, Philadelphia, Pa.*
 Wilbur, P. H., *Little Compton, R. I.*
 Willard, Charles W., *Westerly, R. I.*
 Willetts, J. C., *27 Pine Street, New York City.*
 Williams, J. A., *St. Johnsbury, Vt.*
 Wilson, C. H., *Glens Falls, N. Y.*
 Wilson, S. H., *Cleveland, O.*
 Winn, Dennis, *Nashua, N. H.*
 Winn, S., *Carolina, R. I.*
 Wires, S. P., *Lester Park, Duluth, Minn.*
 Wisner, J. Nelson, Jr., *United States Bureau of Fisheries,
 Washington, D. C.*
 Wolf, Herman T., *489 The Bourse, Philadelphia, Pa.*
 Wood, C. C., *Plymouth, Mass.*
 Wood, Frank, *Edenton, N. C.*
 Worth, S. G., *Edenton, N. C.*
 Wride, George A., *Grindstone City, Mich.*
 Zalsman, Philip G., *Paris, Mich.*
 Zacharie, Col. F. C., *345 Corondelet St., New Orleans, La.*
 Zweighapt, S., *Deer Park, Haines Falls, N. Y.*

HONORARY.

- Borodiné, Nicholas, *Delégate of the Russian Association of
 Pisciculture and Fisheries, Uralsk, Russia.*
 Cortelyou, Hon. George B., *Washington, D. C.*
 Denbigh, Lord, *Colonel of the Honorable Artillery Company,
 London, England.*
 Fish Protective Association of Eastern Pennsylvania, *1020
 Arch Street, Philadelphia, Pa.*
 Fryer, Charles E., *Supervising Inspector of Fisheries, Board
 of Agriculture and Fisheries, 3 Delahay St., London, England.*
 Hamilton, Dr. J. Lawrence, *M. R. C. S., 30 Sussex Square,
 Brighton, England.*
 Hofer, Prof. Dr. Bruno, *Munich, Germany.*
 Kishinouye, Dr. K., *Imperial Fisheries Bureau, Tokyo,
 Japan.*
 Lake St. Clair Shooting and Fishing Club, *Detroit, Mich.*

Matsubara, Prof. S., *President Imperial Fisheries Institute, Tokyo, Japan.*

Metcalf, Victor H., *Secretary of the Department of Commerce and Labor, Washington, D. C.*

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

Peck, Hon. George W., *Milwaukee, Wis.*

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

The President of the United States.

The Governors of the Several States.

Woodmount Rod and Gun Club, *Washington, D. C.*

CORRESPONDING.

Ayson, Lake F., *Wellington, New Zealand.*

Ayson, Charles L., *Hakataemen, Oamaru, New Zealand.*

Apostolides, Prof. Nicolay Chr., *Athens, Greece.*

Armistead, J. J., *Dumfries, Scotland.*

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

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

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

Fedderson, Arthur, *Copenhagen, Denmark.*

Feilding, J. B., *Upper Downing, Holywell, North Wales.*

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

Ho., 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.*

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	453
Honorary	61
Corresponding	22
	<hr/>
Total membership	536

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

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

AT ITS
Thirty-fourth Annual Meeting

JULY 25, 26 AND 27, 1905,

At White Sulphur Springs, West Virginia.

303706
22.8.40

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1905.

Officers for 1905-1906.

<i>President</i>	C. D. JOSLYN, Detroit, Mich.
<i>Vice-President</i>	H. M. SMITH, Washington, D. C.
<i>Recording Secretary</i>	GEORGE F. PEABODY, Appleton, Wis.
<i>Corresponding Secretary</i>	CHARLES G. ATKINS, East Orland, Me.
<i>Treasurer</i>	C. W. WILLARD, Westerly, R. I.



EXECUTIVE COMMITTEE.

HON. W. E. MEEHAN, <i>Chairman</i> ,	Harrisburg, Pa.
JOHN D. WHISH,	Albany, N. Y.
E. HART GEER,	Hadlyme, Conn.
J. A. HENSHALL,	Bozeman, Mont.
PAUL NORTH,	Cleveland, O.
J. J. STRANAHAN,	Bullochville, Ga.
S. F. FULLERTON,	St. Paul, Minn.

AMERICAN FISHERIES SOCIETY.

Organized December, 1870.

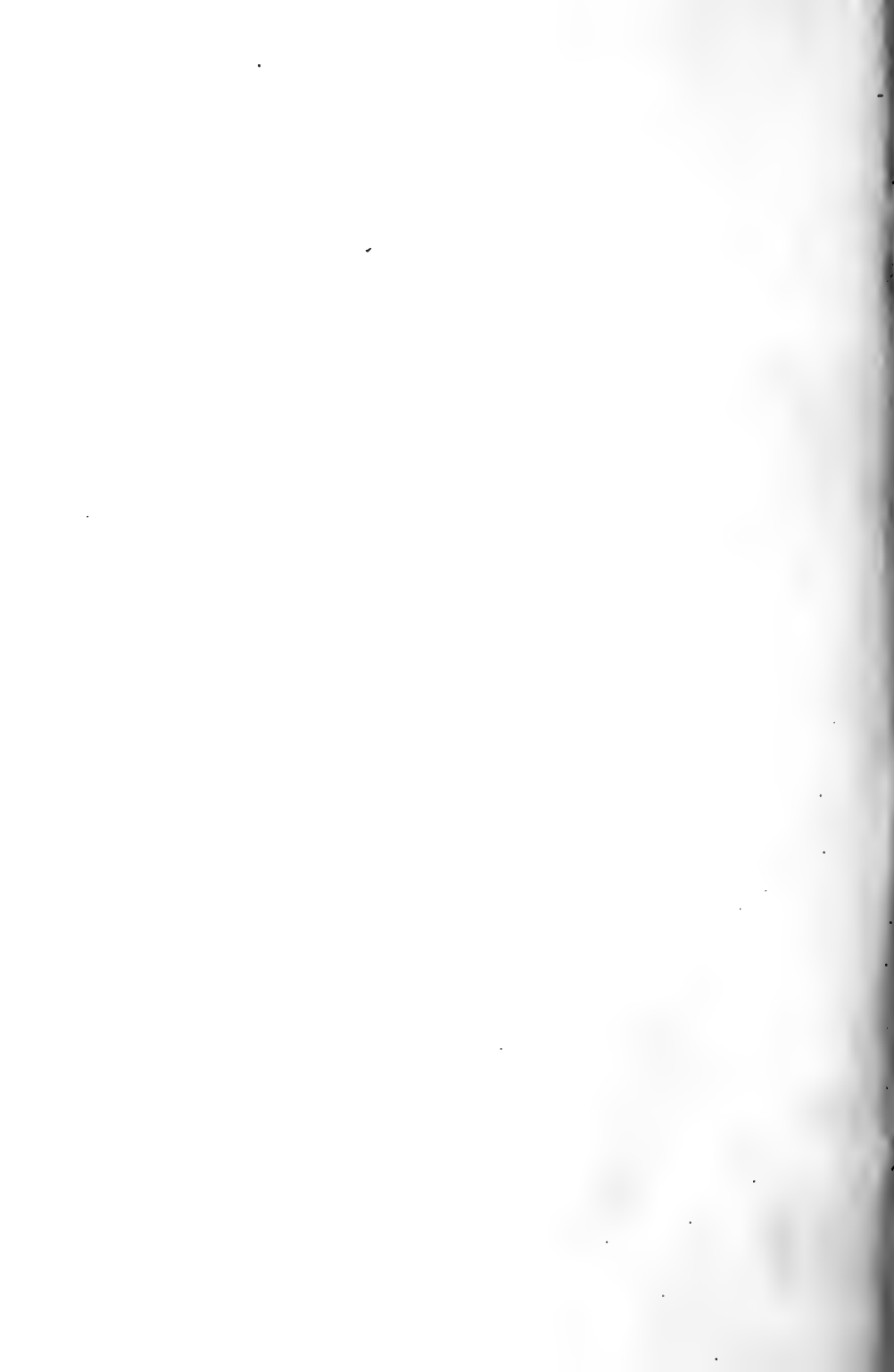
PRESIDENTS.

1.	William Clift.....	1870-1871
2.	William Clift.....	1871-1872
3.	William Clift.....	1872-1873
4.	Robert B. Roosevelt.....	1873-1874
5.	Robert B. Roosevelt.....	1874-1875
6.	Robert B. Roosevelt.....	1875-1876
7.	Robert B. Roosevelt.....	1876-1877
8.	Robert B. Roosevelt.....	1877-1878
9.	Robert B. Roosevelt.....	1878-1879
10.	Robert B. Roosevelt.....	1879-1880
11.	Robert B. Roosevelt.....	1880-1881
12.	Robert B. Roosevelt.....	1881-1882
13.	George Shepard Page.....	1882-1883
14.	James Benkard.....	1883-1884
15.	Theodore Lyman.....	1884-1885
16.	Marshall McDonald.....	1885-1886
17.	W. M. Hudson.....	1886-1887
18.	William L. May.....	1887-1888
19.	John H. Bissell.....	1888-1889
20.	Eugene G. Blackford.....	1889-1890
21.	Eugene G. Blackford.....	1890-1891
22.	James A. Henshall.....	1891-1892
23.	Herschel Whitaker.....	1892-1893
24.	Henry C. Ford.....	1893-1894
25.	William L. May.....	1894-1895
26.	L. D. Huntington.....	1895-1896
27.	Herschel Whitaker.....	1896-1897
28.	William L. May.....	1897-1898
29.	George F. Peabody.....	1898-1899
30.	John W. Titcomb.....	1899-1900
31.	F. B. Dickerson.....	1900-1901
32.	E. E. Bryant.....	1901-1902
33.	George M. Bowers.....	1902-1903
34.	Frank N. Clark.....	1903-1904
35.	Henry T. Root.....	1904-1905
36.	C. D. Joslyn.....	1905-1906



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PART I.

BUSINESS SESSIONS.



Transactions of the American Fisheries Society.

Tuesday, July 25th, 1905.

Convention called to order at 12 M. by the President, Mr. Henry T. Root, of Providence, Rhode Island, at the Grand Central Hotel, White Sulphur Springs, West Virginia, where-upon the following proceedings were had:

President: Gentlemen of the American Fisheries Society, you will please come to order. The first order of business will be to secure the register of attendance, and I will ask Mr. Whish to make the register.

The registered attendance at the meeting of the society is as follows:

Atkins, Charles G., *East Orland, Me.*

Booth, DeWitt C., *Spearfish, S. D.*

Bower, Seymour, *Detroit, Mich.*

Bower, Ward T., *Northville, Mich.*

Bowers, Hon. George M., *U. S. Bureau of Fisheries, Washington, D. C.*

Brooks, Charles F., *Sandy Springs, Md.*

Brower, J. E., *Holmsburg, Philadelphia, Pa.*

Buller, A. G., *Erie, Pa.*

Buller, William, *Corry, Pa.*

Buller, N. R., *Pleasant Mount, Pa.*

Burner, W. J., *Durbin, W. Va.*

Clark, Frank N., *Northville, Mich.*

Cruikshank, James, *New York City.*

Dean, Herbert D., *U. S. Bureau of Fisheries, Neosho, Mo.*

Degler, F. A., *Cheat Bridge, W. Va.*

Dennis, Oregon M., *Baltimore, Md.*

Dinsmore, A. H., *Bucksport, Me.*

Downing, S. W., *Put-in-Bay, O.*

DePuy, Henry F., *New York City.*

Evermann, Prof. Barton W., *U. S. Bureau of Fisheries,
Washington, D. C.*

Fullerton, Samuel F., *St. Paul, Minn.*

Gorham, F. P., *Providence, R. I.*

Greene, D. D. W., *Ohio Fish and Game Commission, Day-
ton, O.*

Haas, William F., *Corry, Pa.*

Harron, L. G., *U. S. Bureau of Fisheries, Washington, D. C.*

Hogan, James J., *La Crosse, Wis.*

Hubbard, Waldo F., *Nashua, N. H.*

Joslyn, C. D., *Detroit, Mich.*

Lydell, Dwight, *Mill Creek, Mich.*

Marsh, M. C., *U. S. Bureau of Fisheries, Washington, D. C.*

Meehan, W. E., *Commissioner of Fisheries, Harrisburg, Pa.*

Miller, Charles L., *Altoona, Pa.*

Morton, William P., *Providence, R. I.*

North, Paul, *Ohio Fish and Game Commissioner, Cleve-
land, O.*

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

Price, Andrew, *Marlinton, W. Va.*

Price, Calvin W., *Marlinton, W. Va.*

Roberts, A. D., *Woonsocket, R. I.*

Robinson, Robert K., *White Sulphur Springs, W. Va.*

Root, Henry T., *President, Providence, R. I.*

Safford, W. H., *Department of Fisheries, Bellefonte, Pa.*

Seagle, George A., *Wytheville, Va.*

Smith, Dr. H. M., *U. S. Bureau of Fisheries, Washington,
D. C.*

Smith, Captain James A., *Baltimore, Md.*

Surber, Thaddeus, *White Sulphur Springs, W. Va.*

- Talbot, Henry, *Interstate Commerce Commission, Washington, D. C.*
 Thompson, James F., *Martinsburg, W. Va.*
 Titcomb, John W., *U. S. Bureau of Fisheries, Washington, D. C.*
 Townsend, C. H., *The Aquarium, New York City.*
 Venn, Harry S., *White Sulphur Springs, W. Va.*
 Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*
 Whitaker, Andrew R., *Phoenixville, Pa.*
 Willard, C. W., *Treasurer, Westerly, R. I.*
 Worth, S. G., *Beaufort, N. C.*

The Treasurer then presented his report as follows:

To the American Fisheries Society of the United States of America.

Gentlemen:—I herewith submit my annual report as Treasurer from July 21, 1904, to July 25, 1905:

RECEIPTS.

Life membership fees.....	\$ 75.00	
Yearly dues.....	389.20	
Special printing fund.....	50.00	
Sale of thirty-seven reports.....	18.50	
		————— \$532.70

1904.

EXPENDITURES.

July 26—Balance due Treasurer.....	\$ 46.50	
Aug. 3—1,000 blank receipts.....	2.75	
Aug. 17—500 stamped envelopes.....	10.70	
Aug. 20—Otto P. Bahn, use of stereopticon.....	5.00	
Oct. 3—H. D. Goodwin, stenographer.....	140.00	
1905.		
Jan. 5—500 stamped envelopes.....	10.70	
Jan. 20—Post Publishing Co.....	311.95	
Jan. 20—George F. Peabody, Secretary, postage, etc.	73.83	
June 15—Typewriting letters.....	1.50	
July 15—Post Publishing Co.....	13.75	
July 15—George F. Peabody, Secretary, postage, etc.	21.64	
July 15—The J. C. Hall Co., receipt books.....	6.25	
		————— \$644.57
July 25—Balance due Treasurer.....		\$111.87

Respectfully submitted, \$644.57
 C. W. WILLARD, Treasurer.

Motion made, seconded and unanimously carried, that the report be referred to auditing committee.

President: I will appoint as members of the committee Mr. Robert K. Robinson and Mr. N. R. Buller.

Treasurer: In addition to the formal report which I have made, I desire to state that a deficit in our treasury at this time was not unexpected by me, for the reason that our new rate of \$2.00 per year will not go into effect until the present year. In January I found it necessary to advance to the society about \$250 to meet maturing obligations. This shortage or deficit has been somewhat reduced by several life membership fees paid since that time. I have no doubt but that with the annual dues now raised to \$2.00 we shall be able to meet all expenses during the coming year.

The following is a list of applicants for membership in the association, made since the last meeting:

- Barbour, Thomas, Museum of Comparative Zoology, Cambridge, Mass. (Proposed by C. H. Townsend, Director New York Aquarium.)
- Beaman, D. C., Boston Bldg., Denver, Col. (By G. F. Peabody.)
- Beeson, W. E., Fire Arms, Ammunition, Fishing Tackle, (With Foster, Stevens & Co., Grand Rapids, Mich.)
- Brewer, E. S., Owosso, Mich. (By Frank N. Clark.)
- Brower, J. F., Torrissdale Hatchery, Holmesburg, Pa. (By W. E. Meehan.)
- Buck, William O., East Orland, Me. (By G. F. Peabody.)
- Burner, W. G., Durbin, W. Va. (By F. A. Degler.)
- Butler, H. A., Mauch Chunk, Pa. (By W. E. Meehan.)
- Clark, C. C., 306 E. South street, South Bend, Ind. (By Frank N. Clark.)
- Cruikshank, James, 217 Central Park, West, New York. (By J. W. Titcomb.)
- Curry, W. F., Freeland, Pa. (By W. E. Meehan.)
- De Puy, Henry F., 296 West End avenue, New York. (By J. W. Titcomb.)

- Donahue, L. H., Leadville, Col., U. S. Bureau of Fisheries.
(By A. H. Dinsmore.)
- Douglass, W. B., St. Paul, Minn. (By S. F. Fullerton.)
- Fassett, H. C., U. S. Bureau of Fisheries, Washington,
D. C. (By G. F. Peabody.)
- Gardener, W. E., Hollidaysburg, Pa. (By W. E. Meehan.)
- Gibbs, Charles, East Orland, Me. (By G. F. Peabody.)
- Grindle, C. S., East Orland, Me., U. S. Bureau of Fisheries.
(By A. H. Dinsmore.)
- Haas, William, Corry, Pa. (By W. E. Meehan.)
- Hall, C. E., Superintendent Parkside Hatchery, Cresco, Pa.
(By M. G. Sellers, Secretary Pennsylvania Fish Pro-
tective Association, 420 Chestnut street, Philadelphia.)
- Helmer, D. S., Post Allegheny, Pa.
- Helmer, E. R., Post Allegheny, Pa.
- Hempshill, T. J., Hollidaysburg, Pa. (By W. E. Meehan.)
- Henkel, C. D., Bureau of Fisheries, Tupelo, Miss. (By C.
P. Henkel.)
- Henry, W. S., Parkside, Pa. (By W. E. Meehan.)
- Hines, W. B., White Sulphur Springs, W. Va.
- Irish, Clifford E., Lake George, N. Y. (By G. F. Peabody.)
- Johnson, O. J., Glenwood, Minn. (By S. F. Fullerton.)
- Keesecker, A. G., Fishery, Tenn.
- Lamprey, Judge Uri L., St. Paul, Minn. (By S. F. Full-
erton.)
- McCook, George M., Ohio Fish and Game Commission,
Steubenville, O.
- Marchers, George, London, O. (By Dr. Greene.)
- Martin, Timothy J., Davis, Collamore & Co., Fifth avenue,
New York. (By E. M. Waterhouse.)
- Meeker, D. W., Moorehead, Minn. (By S. F. Fullerton.)
- Miller, Walter H., U. S. Bureau of Fisheries, Spearfish,
S. D. (By G. F. Peabody.)
- North, Paul, Cleveland, Ohio.
- Orahood, H. M., 1010 17th street, Denver, Col. (By G.
F. Peabody.)

Palmer, Stephen S., Monticello, N. Y. (By E. M. Waterhouse.)

Paxton, Thomas B., Ohio Fish and Game Commission, Cincinnati, O.

Peoples, Hon. Hiram, New Providence, Pa. (By H. C. Demuth.)

Price, Andrew, Attorney-at-Law, Marlinton, W. Va. (By F. A. Degler.)

Rankin, J. H., Ohio Fish and Game Commission, South Charleston, O.

Safford, W. H., Department of Fisheries, Harrisburg, Pa. (By W. E. Meehan.)

Smith, H. G., Minneapolis, Minn. (By S. F. Fullerton.)

Snyder, J. P., U. S. Bureau of Fisheries, Spearfish, S. D. (By G. F. Peabody.)

Stevenson, Charles H., Bureau of Fisheries, Washington, D. C.

Tankerslay, A. S., Bureau of Fisheries, Tupelo, Miss. (By C. P. Henkel.)

Taylor, Robert Kirby, 66 Leonard street, New York. (By E. M. Waterhouse.)

Thompson, George B., Davis, W. Va. (By Mr. Robinson.)

Thompson, James F., Martinsburg, W. Va. (By E. M. Waterhouse.)

Wolters, Charles W., Sr., Philadelphia, Pa. (By W. E. Meehan.)

Motion made, seconded and unanimously carried that the rules be suspended and that the secretary cast the ballot of the association electing the foregoing applicants.

(So done.)

The names of the members who have died since the last meeting were then read, and referred to the committee on resolutions.

President: I will appoint the following committees:

Committee on resolutions: Mr. W. E. Meehan, of Pennsylvania, chairman, Mr. Seymour Bower of Michigan, Mr. Charles H. Townsend, of New York.

Auditing Committee: Mr. Robert K. Robinson, chairman, Mr. N. R. Buller.

Committee on nominations: Mr. J. J. Hogan of Wisconsin, chairman, Mr. John D. Whish of New York, Mr. William P. Morton of Rhode Island, Mr. S. F. Fullerton of Minnesota, Mr. Frank N. Clark of Michigan.

Committee on location: Mr. Paul North of Ohio, Mr. Charles F. Brook of Maryland, Mr. John W. Titcomb of Vermont.

Mr. Frank N. Clark: I move that Article II of the constitution be amended by striking out the words "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."

And substituting in lieu thereof the following:

"Any person shall, upon a two-thirds vote, and the payment of twenty-five dollars, become a life member of this society, and shall thereafter be exempt from all annual dues."

Motion made and seconded that the amendment be adopted.

President: I am not going to make any address, because I think we have business of a great deal more importance than any word I could say to you.

An adjournment was then had to the same day and place, Tuesday, July 25th, 1905, 2:30 p. m.

AFTERNOON SESSION.

Same day and place, 3 p. m. Meeting called to order by the President.

President: I will call for the report of the secretary.

Secretary Peabody: The secretary's report for the past year is embodied in the published proceedings, and needs no further addition.

Mr. Clark: I move that the secretary's report be received and adopted, and also that the secretary be thanked for getting

out such an excellent report of our proceedings. I think it is one of the most valuable we have ever had.

Motion seconded and unanimously carried.

President: There is an old committee appointed some years ago to designate the different sizes of fish, which committee was to report at this meeting. Mr. Clark was chairman of that committee and I will call upon him for a report.

Mr. Clark: I believe that I was appointed on a committee consisting of Mr. Seymour Bower, Mr. Ravel and myself, to consider the advisability of agreeing on a suitable nomenclature for bass of various sizes. The question has been up before the committee by correspondence since that time. There are but two members present but I desire to say that as yet we have not been able to come to any agreement on this subject.

I think the best solution of the matter is this: to call the young bass fry until the sac is absorbed. After that time until they are 30 days old call them number 1's. From 30 to 60 days number 2's, after that time number 3's. I think Mr. Bower's idea is a reversal of that plan. He would call the young bass number 3's, the middle class, or those 30 days old, or over, number 2's and 60 days or over number 1's. From that time on they are yearlings.

Mr. Ravel wishes them called number 1's after they are 30 days old, number 2's after they are 60 days old, and number 3's after they are 90 days old. Now that is as near as the committee could get together at the present time. I think for the purpose of an easy way to get at it in distributing fish, the best way is to adopt the classification of number 1's, 2's and 3's, for 30, 60 and 90 day fish respectively. That is my idea. This idea of calling them fry, baby fingerling and fingerlings, is confusing. You cannot tell anything about them. I have up in my room small mouth bass that are not to exceed an inch long which are 56 days old. I have some there also that are $3\frac{1}{4}$ inches long that are 56 days old. They would be called, under the old nomenclature, baby fingerlings and fingerlings. I should like to hear from the others on this subject. Maybe Mr. Bower has something to say.

Mr. Seymour Bower: I thought Mr. Clark and I were go-

ing to get together before this report was made. We had talked it over a little, and there are some good reasons why the classification as he has given it to you, is all right, and there are some objections to it. Bass of the same age vary so in size that it seems to me that it is better to classify them according to size rather than age. A late hatched 30 day fish, where the water is warm, may be twice as large as one hatched early and a good deal older under different temperature and food conditions. It is a rather confusing matter, and I would like to hear from the other members of the society on this point.

President: This is a matter that ought to be settled. Of course we are all interested when we are asking the government for fish to know what to order, and what we may expect to get, and if we could settle the question here and get it into our minutes, we would be all right on that question, and I would like to hear from Mr. Titcomb on that point. He is in direct communication with the supply department, and perhaps could suggest some standard.

Mr. Titcomb: We distribute from the Bureau of Fisheries fry, fingerlings, and yearlings, so-called. We have never used the term baby fingerlings, and when we speak of a fingerling it may be a fish three months old, or it may be six months old. Of course there is a great variation in size of different species of the same age; and fingerling bass would be very much smaller than fingerling trout, perhaps. The fish have been designated as yearlings after they are six months old, you might say, although they are not nearly a year old, and that term has been applied quite as much to size as to actual age.

Now, so far as I understand the question, it is not what the applicant is going to get. We do not tell them whether we are going to give them fry or baby-fingerlings or yearlings. We have to be guided in that by the convenience of the bureau in making the distributions. We can distribute to some states in the spring of the year, and to others early in the fall; and so some are more fortunate than others. In some places we make two distributions. But it occurred to me that if we could designate fish as fry, and then afterwards as number 1, 2, 3 and 4, etc., for the number of months they have been fed after

that time, it would let one know what is being planted, so far as the fish culturist is interested in it. The outsider does not know much about it anyway, and so far as the bureau is concerned we keep a sample lot of fish distributed by each station; that is, when these fish are distributed, a sample lot of them is sent to Washington, and one can see in Washington the size of the fish distributed from the various stations of the bureau at various periods of the year. You could thus tell, under the new designation, just what number 1 or number 2 means, if the nomenclature should be adopted.

I cannot see a much clearer way to designate fish than by numbers. It is not necessary to make the reports by numbers and get it down as fine as that. You might have afterwards a general tabulation as fry, fingerlings and yearlings. As far as the public is concerned, that is enough. But when we are talking fish culture in these meetings we want to know the age rather than the size.

President: This committee has not come to any conclusion, and if there is no objection we will give them further time. Perhaps they may get on some basis on which they can report at another meeting.

We will listen to the report of the executive committee, Mr. Meehan chairman.

Mr. Meehan: There was only one matter that came before the executive committee during the year, and that was in the case of Dr. Smith, who having to make a trip to Europe suggested to the committee that he be made a representative of the American Fisheries Society to the International society, and an effort be made to have the society meet in the United States the following year. I placed myself in communication with the president of the society at once, and the necessary papers were sent to Dr. Smith. Unfortunately he did not receive them until it was too late, although there was no delay in complying with his request, but I think probably, unless I am mistaken, he had to move faster than he anticipated in the beginning. That is all that came before the committee during the year.

President: Did it put you under any embarrassment, not having your papers?

Dr. Smith: I should have been glad to serve as representative of the American Fisheries Society at the International Fisheries Congress, but as I was not provided with any official papers I could not so serve. The papers appear to have been sent to me in due time, but failed to reach me until three weeks after the congress had adjourned.

Secretary: I suggest that inasmuch as Dr. Smith was really the representative of the society, that he give us a brief account of the proceedings.

Dr. Smith: I would prefer to leave the matter until tomorrow when I will have something to say on the subject.

Dr. Smith then read a paper by Mr. Henry O'Malley, of Baker, Washington, on the subject of "Salt Solution as an Aid to Fish Culture."

Mr. John W. Titcomb then read a paper on "Progress and Experiments in Fish Culture in the Bureau of Fisheries During the Fiscal year of 1905."

Mr. Charles G. Atkins, of East Orland, Maine, then read a paper on the subject of the "Early Feeding of Salmonoid Fry."

A discussion was had in regard to the age to which brook trout lived.

Mr. John D. Whish of Albany, New York, then read a paper on the subject of "The Passing of the Native Brook Trout."

Meeting adjourned until 8:30 p. m. same day, July 25th, 1905, and place.

EVENING SESSION.

Same day and place, 8:30 p. m. Meeting called to order by the President.

President: Two years ago Mr. Titcomb visited Argentina, and last year at Atlantic City gave us an account of his explorations, but without the use of a stereopticon. Tonight he will give us some descriptive stereopticon illustrations of his trip, with comments.

Mr. John W. Titcomb delivered a lecture with stereopticon illustrations on the subject of "Reminiscences of a Trip to South America."

Dr. Barton W. Everymann exhibited slides illustrating the Golden Trout of Volcano Creek.

Adjourned until July 26th, 1905, 10 a. m., at the White Sulphur Springs Hatchery.

Wednesday, July 26.

White Sulphur Springs Hatchery, July 26th, 1905, 10 a. m.
Meeting called to order by the President.

Various apparatus, consisting of fish culture appliances, were exhibited and described.

President: Gentlemen of the American Fisheries Society, it affords me a great deal of pleasure to inform you that Gov. Dawson of this state is present with us at this time. I am sure we will all appreciate his presence as a very marked courtesy to us, and we shall all remember it. It is something that we have not had before in many of our meetings; although I think we did give you the Governor in Rhode Island. We try to do things there as well as we can. (Great applause.)

Hon. William M. O. Dawson, Governor of West Virginia: Mr. President, Ladies and Gentlemen, some time ago I had a letter from our commissioner, Mr. Bowers, whom I have no doubt you all appreciate as we appreciate him in West Virginia. He is one of our own productions and you will see from his size and otherwise that we are not ashamed of him. (Laughter.) You know his reputation as a fish commissioner, you know what he has done for that branch of the service, and he has pleased the president and pleased us, which is more important to us than pleasing the president, but not quite so important to him as pleasing the president; and I am sure he has pleased all you gentlemen, who give your time, and many of your means, gratuitously, to this important business.

I say I had a letter from him some time ago telling me of this meeting; that you had honored West Virginia with hav-

ing your annual session here at this beautiful spot, the old "White Sulphur," and asking me to come and see you. I promised I would, but when the time came it was almost impossible for me to be present; but inasmuch as you gentlemen had come to our state, I wanted to meet and say to you that in behalf of our people we are very glad to have you with us; and we give you the warmest sort of southern welcome.

We are not only glad to have you with us at this time, but we hope that your session here will be so pleasant that you will come back and see us again in the future.

Now I do not know very much about the fish business. All of you individually and collectively know a great deal more about that than I do, and hence I will not undertake to lecture you about something that you know more about than I do. That would be presumption on my part. But I understand, gentlemen, that this is a very important industry. I don't know; I have not the statistics here to show what it is worth to us in dollars and cents; but it is worth something to us in other ways beside the mere intrinsic worth. Now West Virginia used to be quite a little state—not because I am Governor; it became a great state before I was Governor, and I hope it will be a greater one when I quit being Governor. That is my ambition. But West Virginia is not a small state in territory. I say to my friend in Rhode Island, that it is somewhat larger than even Rhode Island. (Laughter.) It is not quite as large as Wisconsin in territory, but states like men, are not judged from their size. I do not say this in detriment to my friend, the commissioner. (Laughter.)

Mr. Bowers: You have no business to look at me when you say that.

Gov. Dawson: Nor to my friend, the Hon. Charles F. Teeter, whom we are glad to have with us today, but I say that in defense of myself. Self-preservation is the first law of nature. West Virginia is to be judged first by the men produced, like our fish commissioner, and our senators and congressmen, and then it is to be judged by the material things it produces. United States could not get along well without West Virginia. Take West Virginia out of existence in the union and you would

have a great deal less coal, a great deal less timber, and a great deal less poultry, and a great deal less of a great many necessary things. We are in the habit of saying this, and we believe it to be true. Now it may not strike you, because you have not investigated it, but you will take the word of us who have investigated it, that we think West Virginia is the richest state in the union. Of course it is just on the eve of its development; and if any of you gentlemen are thinking of changing your location, I do not know of a better place in the world to settle than in West Virginia, and we will be glad to have you.

Now, as I said, I just came here to say a few words to you, to welcome you, and to tell you how glad we are to have you with us, to wish you a good time and to hope that you will come back and see us again as soon as you can.

I thank you gentlemen.

(Great applause.)

Dr. H. M. Smith then read a paper written by Mr. George R. Allen of Portland, Oregon, on the subject of "Notes on the Feeding of Parent Trout with Reference to Virility of Eggs Produced."

Mr. Henry Talbott of Washington, D. C., then read a paper on the subject of "Potomac Bass."

Mr. Oregon Milton Dennis, Secretary and Counsel, Maryland State Game and Fish Protection Association and Assistant State Game Warden of Baltimore, Maryland, then read a paper on "Fish Protection."

President: In our opening exercises yesterday in calling for reports of committees, Mr. Atkins was not present and I did not call for the report of the committee on foreign relations. It is a very important committee and I will call for a report from him.

Mr. Atkins: The committee of Foreign Relations beg to say that during the year they have met with some impediments and causes for delay in the work that was laid out for them; so that at the end of the year they find themselves unable to present the sort of report which they think would meet the resolution authorizing their appointment, and therefore they beg the

pardon of the society for not bringing forward a report at this time, and ask to be allowed to bring one forward at the next meeting.

(Committee continued.)

Dr. Smith then read a paper by Dr. James Henshall of Bozeman, Montana, on the "Protection of Fish in Inland Waters."

Adjourned to 2:30 p. m. same day, Wednesday, July 26, 1905, at the White Sulphur Springs.

AFTERNOON SESSION.

Wednesday, July 26th, 1905, 3 p. m., convention called to order at the hotel by the president.

Dr. Barton W. Evermann, of Washington, D. C., then spoke on the subject of the "Golden Trout of Volcano Creek."

President: We have a report from one of the committees now ready, the committee on nominations, and I will ask the secretary to read it.

The secretary read the report of the committee on nominations as follows:

Mr. President, your committee on nomination do most respectfully submit the following report:

OFFICERS, 1905.

President, C. D. Joslyn, Detroit, Mich.

Vice President, H. M. Smith, Washington, D. C.

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

Corresponding Secretary, Charles G. Atkins, East Orland, Maine.

Treasurer, C. W. Willard, Westerly, Rhode Island.

EXECUTIVE COMMITTEE.

Hon. W. E. Meehan, Chairman, Harrisburg, Pa.

John D. Whish, Albany, N. Y.

E. Hart Geer, Hadlyme, Conn.

J. A. Henshall, Bozeman, Mont.

Paul North, Cleveland, O.

J. J. Stranahan, Bullochville, Ga.

S. F. Fullerton, St. Paul, Minn.

Report of Committee on Nomination.

J. J. HOGAN,

Chairman of Committee.

Motion made, seconded and unanimously carried, that the rules be suspended, that the report be adopted; and that the secretary be instructed to cast the vote of the society for the candidates.

(So done.) (Applause.)

President (to Mr. Joslyn): I will say briefly on behalf of the society, but more on my own behalf, that I think the society is to be congratulated on your election to this honorable position. To be elected to preside over a body of scientific men, and men of wisdom and experience, is a great honor. I only regret that the rules of this body do not allow me to put you in this chair at this time; but I think Mr. Clark and others have held the chair until the end of the session, so until a year from now you will have to be considered president-elect.

Mr. Joslyn: Mr. President, I fully appreciate all that you say about the dignity and honor of the position which you now hold, and which we are all pleased to have you hold until the end of this meeting.

Last year this society did me what I considered then, and so told it, the high honor of electing me vice-president. I believe I told you then that I appreciated the character of the work of this body, and I certainly appreciate it more as I have looked into it further. It will be my endeavor, so long as I am president, to do nothing of which any one of you shall ever have the right to complain. It will be my aim to do everything I can to further the best interests of the society in every way that I know how.

This is not the time to make a speech, Mr. President, but since I am on my feet I take this occasion once for all to thank you most sincerely and earnestly for the high honor which you have conferred upon me.

(Great applause.)

President: Following the precedent of last year we should like to hear from Dr. Smith, vice-president elect.

Dr. Smith: The best thing I can say is, "Me too." President Joslyn has said everything that I have to say, and I bespeak for him the cordial support of the society. I thank you very much indeed for the honor you have conferred upon me.

(Applause.)

President: We will now resume the regular order of business. Dr. A. D. Mead of Providence, Rhode Island, has prepared a paper on "Experimental Work of the Rhode Island Commissioners of Inland Fisheries." But he has gone to Europe and Dr. Gorham has kindly, at our solicitation, volunteered to come on here and read the paper. I will say that Dr. Gorham has taken the place of Dr. Mead, and is in full charge of our Marine Laboratory during Dr. Mead's absence.

Dr. Gorham then read the paper referred to.

Mr. Frank N. Clark of Northville, Michigan, then read a paper on "Notes on Small Mouth Bass Culture at the Northville Station."

President: In regard to the question of the grading or classification of fish, I do not know but that it would be well to add to the committee that has that in charge.

Mr. Clark: I would like to move that this committee be discharged and a new committee appointed, because the three present members will never agree.

Motion seconded.

Mr. Seymour Bower: I think that motion should be carried unanimously, and in order to be relieved from duty on that committee, I will make a motion that we adopt as a standard for bass, to call them fry, after $\frac{3}{4}$ of an inch in length; $\frac{3}{4}$ to $1\frac{1}{2}$ inches, call them No. 1; $1\frac{1}{2}$ to $2\frac{1}{2}$, No. 2; $2\frac{1}{2}$ to 3, No. 3, and beyond that fingerling bass.

President: There is a motion previous to this that the committee be discharged. The motion was properly seconded and the question is before you.

Dr. Smith: It seems to me it would be unfortunate for the society to lose the benefit of all the talk and time this committee has put on this subject. Would it not be a good idea to simply enlarge the committee by the injection of some new blood, and insist on a report at the next year's meeting?

Mr. Titcomb: I second Dr. Smith's motion, which is that two more members be added to this committee and this whole question be referred again to the committee.

Motion to discharge the committee was lost.

Dr. Smith: I move that the present committee be increased to five, and that they report at the next annual meeting.

Motion seconded.

Amendment made that the committee report tomorrow.

Dr. Smith: This matter will have to be decided on arbitrary lines, and it does not seem worth while to defer this settlement indefinitely, so it may perhaps be expedient for the committee to meet and report before we adjourn, and I accept the amendment.

Dr. Smith: I will change my motion so that it will read as follows: I move that the present committee be increased by adding four new members, and that they report tomorrow.

Motion seconded and unanimously carried.

President: I will add to that committee Messrs. North, Smith, Meehan and Whish.

Mr. Clark: The chairman of that committee will call a meeting of that committee right after the conclusion of this meeting and decide what we will do.

A resolution regarding the destruction of fish was then read and referred to the committee on resolutions.

President: The programme this evening will be a five minutes talk by Dr. Smith of the United States Bureau of Fisheries on his "Observations of the Fisheries Congress at Vienna," and an illustrated lecture by Mr. A. H. Dinsmore, on the "Yellowstone Park."

A recess was here taken till 8:30 p. m., same day and place.

EVENING SESSION.

Same day and place, 8:30 p. m. Meeting called to order by the president.

Mr. A. H. Dinsmore of Leadville, Colorado, gave a lecture on "The National Park—the Great National Fishing Resort," illustrated by lantern slides.

A recess was taken until the next day, same place, 10 a. m.

Thursday, July 27.

Same place, July 27, 1905, 10 a. m. Meeting called to order by the president.

Mr. Clark called up the discussion of Dr. Henshall's paper.

Motion made, seconded and unanimously carried, that the matter of the destruction of fish by irrigation, brought up by the paper presented by Dr. Henshall, be referred to the committee on resolutions.

Report of special committee on grading of fishes was presented by Mr. Clark as follows:

To the American Fisheries Society.

Gentlemen:—Your committee appointed to arrange, if possible, a satisfactory system for designating the various fishes propagated and distributed by the hatcheries of the several states and the United States, has unanimously agreed upon a report. It was readily apparent to the committee that any system to be generally accepted, must combine accuracy and simplicity; must retain the terms familiar to the public, and must show to the fish culturist not only the age but the size of the fish. After a careful and thorough discussion of the propositions advanced, it has been decided to recommend the following terms to be used in describing all fish:

Fry—A fish up to the time the sac is absorbed and feeding begins.

Advanced fry—A fish from the end of the fry period until it has reached the length of one inch.

Fingerlings—Fish between the length of an inch and the yearling stage. The various sizes to be designated as follows:

Fingerling 1—A fish from one inch in length up to two inches.

Fingerling 2—A fish from two inches in length up to three inches, etc.

Yearlings—Fish that are one year old but less than two years old, counting from the date of hatching, and which may also be designated as "Yearlings 1, 2, 3, etc.," according to length.

Respectfully submitted,

CLARK,	SMITH,
BOWER,	MEEHAN,
NORTH,	WHISH,

Committee.

Motion made, seconded and unanimously carried that the report of the committee be received and that the recommendations of the committee be adopted.

President: The report of the committee on resolutions will now be received.

Chairman Meehan then presented the following resolution:

Whereas, Death was unusually busy the past year among members of the American Fisheries Society, six associates having been stricken by his chill hand, and

Whereas, It is deemed fitting to make a minute of tribute to each stricken member, the roll of which is:

Dr. J. C. Parker, *Grand Rapids, Mich.*

Hon. Horace W. Davis, *Grand Rapids, Mich.*

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

Capt. N. Juell, *President of the Royal Society for the development of Norwegian Fisheries, Bergen, Norway.*

Hon. Eugene G. Blackford, *New York.*

Mr. J. W. Hoxsie, *Rhode Island.*

And whereas, by the death of the above named associates the society has lost true friends and valued members, and

Whereas, Hon. Eugene G. Blackford and Dr. J. C. Parker, during their life, rendered conspicuous services in the cause of fish culture and fish protection, therefore,

Resolved, that Mr. John D. Whish of New York be requested to prepare a suitable biographical sketch of Mr. Black-

ford for publication in the proceedings of the National Fishery Society for 1905, and that Mr. C. D. Joslyn of Michigan be requested to prepare a similar sketch of Dr. Parker for the same publication; and that the two gentlemen named be requested to secure photographs of Messrs. Blackford and Parker for the secretary of the society who is authorized to publish the same with the sketches described, in the proceedings.

Unanimously adopted by a rising vote.

Mr. Meehan: The following resolution is offered by the committee, being unanimously approved by it:

Resolved, that in future all regular and special committees shall convene on the second morning of the annual meeting, at hours set previously by the respective chairmen, which will not conflict, and there shall be no regular sessions of the society that morning.

Approved,

W. E. MEEHAN, Chairman,
SEYMOUR BOWER,
C. H. TOWNSEND.

Unanimously adopted.

Chairman: The following resolution was introduced and approved by the committee:

Whereas: The Hon. George M. Bowers, United States Commissioner of Fisheries, has, since his incumbency of his office, evinced a hearty and active interest in the aims and purposes of this society and contributed greatly to its success by making it possible for leading members of his scientific and fish cultural staff to be present at its gatherings and making public the results of their skill and experiments, and

Whereas, during his incumbency Mr. Bowers has materially expanded and improved the effectiveness of the United States Bureau of Fisheries,

Therefore, the American Fisheries Society desires to give public expression of its high appreciation of the able manner in which he has administered the duties of his office, and especially on account of the cordial relations he has established between the United States and the States in fish cultural work, and it desires also to publicly and warmly thank him for the aid and encouragement he has given the society.

Unanimously adopted amid great applause.

Mr. Bowers: I very much appreciate this token of esteem, I assure you. I believe it has been the usual custom to have published a statement showing the work of the United States Fish Commission during the preceding year. I have before me a statement of the fish and eggs distributed by the Bureau of Fisheries during the fiscal year.

I was able to have this prepared complete before leaving Washington. It is usually somewhat sooner than we are able to publish our statement, and in this instance I have not even yet submitted it to the Department of Commerce and Labor, but have given the precedence to the American Fisheries Society on this occasion.

It is as follows:

SUMMARY OF DISTRIBUTION OF FISH AND EGGS DURING
THE FISCAL YEAR 1905.

Species	Eggs	Fry	Finger- lings Yearlings and Adults	Total
Catfish.....	.....	.....	427,402	427,402
Buffalo fish.....	.....	.....	214,000	214,000
Shad.....	378,000	32,859,000	.....	33,237,000
Whitefish.....	60,963,000	268,405,000	.....	329,368,000
Bluefin Whitefish.....	380,000	1,000,000	.....	1,380,000
Lake Herring.....	87,040,000	35,000,000	.....	122,040,000
Quinnat Salmon.....	96,055,775	21,620,288	5,125	177,681,188
Silver Salmon.....	107,000	10,633,900	.....	10,740,900
Blueback Salmon.....	.....	7,819,281	10,000	7,829,281
Steelhead Trout.....	139,400	635,905	51,638	826,943
Rainbow Trout.....	301,000	442,160	345,204	1,088,364
Atlantic Salmon.....	8,000	727,462	289,188	1,024,650
Landlocked Salmon.....	192,000	275,004	130,477	597,481
Blackspotted Trout.....	305,000	41,205	6,388,031	6,734,236
Scotch Sea Trout.....	.....	.....	3,479	3,479
Loch Leven Trout.....	.....	27,000	2,062	29,062
Lake Trout.....	5,320,000	35,993,266	11,469	41,324,735
Brook Trout.....	756,000	8,933,881	1,087,054	10,776,935
Golden Trout.....	.....	157,490	269	157,759
Grayling.....	400,000	450,000	20	850,020
Crappie.....	.....	.....	850,356	850,356
Strawberry Bass.....	.....	.....	9,236	9,236
Rock Bass.....	.....	.....	48,674	48,674
Warmouth Bass.....	.....	.....	2,200	2,200
Small-Mouthed Black Bass.....	.....	.....	181,656	181,656
Large-Mouthed Black Bass.....	.....	.....	662,439	662,439
Bream or Sunfish.....	.....	.....	447,908	447,908
Pike Perch.....	152,750,000	246,148,775	395	398,899,170
Pike.....	.....	.....	62,200	62,000
Yellow Perch.....	5,000,000	139,452,521	326,715	144,779,236
Striped Bass.....	.....	2,463,000	.....	2,463,000
White Perch.....	700,000	23,700,000	.....	24,400,000
Tautog.....	.....	2,983,000	.....	2,983,000
Cod.....	.....	169,577,000	.....	169,577,000
Flatfish.....	.....	203,356,000	.....	203,356,000
Pollack.....	.....	8,456,000	.....	8,456,000
Flatfish.....	.....	116,214,000	.....	116,214,000
TO TALS	410,795,175	1,337,371,138	11,557,197	1,759,723,510

I congratulate you on the success of this meeting. We have been here strictly for business. Every man has faithfully and well performed his duty.

I had prepared here a comparative statement of the total output of the Bureau of Fisheries for the years 1899 to 1905 inclusive, but modesty forbids me to present it.

I thank you for your attention. (Great applause.)

(Report received and filed.)

The report of the resolutions committee was resumed as follows:

Mr. Meehan: Mr. Chairman, the next resolution originates in the committee and naturally carries with it the approval of Commissioner Bowers; and is as follows:

Resolved, that the secretary of this society be requested to forward a copy of the following resolution to the Secretary of the Department of Commerce and Labor of the United States:

To the Hon. Secretary of the Department of Commerce and Labor.

Dear Sir: The American Fisheries Society is organized for the purpose of encouraging and expanding the work of fish culture in the United States. Among its members are nearly all the leading Fish Commissioners of the several states, and nearly all the chief Fish Culturists in the Union, including the United States Commissioner of Fisheries and his able assistants. So important are the proceedings of the Society, that the Department of Fisheries of the great commonwealth of Pennsylvania requires all its superintendents to be present at the meetings, and all the states which lead in fish cultural work regularly have representatives present.

In view of these facts it seems important and in the interest of the work of the United States Bureau of Fisheries, that the same policy as that adopted by Pennsylvania and which was first proposed by Commissioner Bowers last year with respect to his own staff, be regularly in force hereafter, and this society respectfully asks that you will give your approval thereto.

Mr. Bowers: I heartily favor that and ask that it be adopted by a rising vote.

Mr. Clark: Your remarks in regard to Pennsylvania I note. Should not some other states be included?

Mr. Meehan: The other states are properly included.

Secretary: I think it would be well, although Rhode Island is not quite as large as Pennsylvania, yet since it is quite as well and ably represented, to have that state mentioned. I think if the mention of one state is to be made, Rhode Island is certainly entitled to a place, and Michigan also.

Mr. Meehan: I think Mr. Townsend, a member of the committee has a resolution offered apart from the committee on resolutions, that has something to say in regard to Rhode Island. (Resolution reread.)

Mr. Meehan: The reason why Pennsylvania was specifically mentioned was because it has a requirement by its Department of Fisheries that all superintendents be present at these meetings, except in case of illness.

President: I think that is a grand resolution, and I think no state can take exception to it.

Unanimously adopted by a rising vote.

Mr. Meehan: The next resolution is offered by Mr. O. A. Dinsmore, and is recommended unanimously by the committee.

It is as follows:

Whereas, The waters within the Yellowstone Park are peculiarly adapted to the natural propagation of fish, and should be utilized as occasion arises by the United States Bureau of Fisheries for the purpose of securing eggs for restocking national or state hatcheries in public waters in the United States, and, whereas, under the present conditions when the superintendents of the Yellowstone Park are liable to be changed frequently, it is impossible to secure for the fish life that sustained and systematic consideration which the work requires, therefore,

Resolved, by the American Fisheries Society that the proper National authorities authorize the Bureau of Fisheries to take exclusive charge of fish and fisheries in the Yellowstone Park.

Resolved, further, that a copy of this preamble and resolution be forwarded to the Secretary of the Department of Commerce and Labor.

Mr. Meehan: The next resolution was offered by Mr. Fullerton of Minnesota, commending the efforts which have been made and being made to cede to the national government jurisdiction over the fisheries of the Great Lakes and interstate waters. This resolution is so important that the committee felt it had better be brought before the convention for full and free discussion, without formal recommendation by the committee.

Motion made and seconded to adopt the resolution.

Mr. Clark: In view of the fact that we have a paper on that line, by Mr. Joslyn, would it not be well to hold the resolution open until we hear from him? He may have some things touching directly upon the point, and the resolution might want to be added to, or something of the kind, and would there be any harm in allowing it to lie over until after his paper has been presented?

Mr. North: Why not have Mr. Joslyn's paper read now?

Mr. Meehan: The committee is still reporting, and I agree with Mr. Clark myself, that that should be the procedure, if agreeable to the Chairman and the meeting.

Mr. Bowers: I move that action on that resolution be deferred until after the reading of Mr. Joslyn's paper.

The resolution was laid on the table, to be called up at any time.

Mr. Meehan: Mr. Oregon Milton Dennis of Baltimore offers the following resolution which is approved by the committee.

Whereas, The attention of the American Fisheries Society has repeatedly been called to the rapid increase in the wholesale destruction of fish by means of illegal nets and other devices; by dynamite and by the pollution of the streams from sugar beet factories, tanneries, chemical works, wood pulp factories and other manufacturing establishments and by sawdust: and

Whereas, The American Fisheries Society regards with grave apprehension this wholesale destruction of an industry, the first value of which is upwards of seventy-five millions of dollars, and to preserve which few legislatures have taken adequate measures; and

Whereas, It is patent to this Society, that under existing conditions it is difficult for artificial propagation of fish to keep pace with this destruction; therefore, be it

Resolved, By the American Fisheries Society, assembled at White Sulphur Springs, West Virginia, this 26th day of July, 1905, that the legislatures of the several states be requested to enact such measures, without delay, as will prevent further destruction of fish life, particularly by laws forbidding the taking of undersized fish and the destruction of spawn by improper use of nets, and by legislation forbidding further pollution of the waters; and be it further

Resolved, That the Secretary of the American Fisheries Society be, and he is hereby, instructed to send a copy of this preamble and resolution to the Governor of each state with a request that he transmit the same to the legislature of his particular state when assembled.

Motion made to adopt the resolution. Seconded.

Mr. Fullerton: The protection of fish ought to go hand in hand with their propagation. It is all right for us to adopt the resolution, but every man of us should go to our different states and work, and see that the legislatures of our different states put something into practice. Last winter we had a meeting in Chicago and I do not know how many states were represented.

Mr. Clark: Seven or eight, I think.

Mr. Fullerton: We passed resolutions of the strongest kind, and went to our different legislatures to do something. I think Michigan was represented by eight or ten people. There were several members of the legislature present. The deputy speaker was there; and I expected, of course, to hear from Michigan, and that their legislature would take some action on this matter. But I have yet to see that any action was taken.

In our state the entire legislature, by unanimous vote, passed a resolution addressed to congress that they would see any jurisdiction that they might have over the great lakes, protected. We do not want to sit here and merely pass resolutions, but go home to our different states and work, and see that these resolutions are carried out. (Applause.)

Mr. Meehan: In regard to the pollution of streams, we made such a fight before the legislature this year that we compelled the manufacturers, so to speak, to sit up, and did succeed in getting a moderate anti-water-pollution measure passed; and we will succeed, I hope, in the next legislature, in getting something better, but we are suffering very much from water pollution; I think in Pennsylvania more perhaps than in most of the states; because until this time we were at the foot of the roll of states in preserving the purity of the waters of any particular state. I believe this resolution should be approved, and approved by a rising vote.

I think furthermore that the resolution itself should be given the very widest publicity, to give it all the power and force of the support of this society; and I think we should all work to secure the passage of proper protective measures in our respective legislatures.

Last year we formed a state organization and it is a pretty strong organization this year. It was so strong that it was able to effect legislation in favor of the fish; and the prospects are that it will be exceedingly powerful before long. To give an idea of the strength of that organization I may say that one measure came up last winter to which a certain senator was very much opposed, because his constituents, he claimed, were opposed to it—as he said: “The manufacturing interests.” It was on the question of water pollution. Within ten days that man said: “I would like to know who said I was opposed to this measure on water pollution; I never said I was opposed to it. I want to do what my constituents say. I have had no less than 2000 letters come to me, demanding that I vote for the bill, and I am for it.” It was the fish protective organizations connected with the State Society which were back of the letter-writing.

Mr. Joslyn: I want to stand up and be counted on this question. It is time, I think, that every state in the union stood up to be counted. This is not a question merely of preserving some financial or commercial industry, it is a question of preserving a cheap and healthful food for all the people of the country.

It has seemed to me, Mr. President, in view of the various troubles that our sister state New York is in, that it is pretty

near time to appoint for her a physician or a guardian, or possibly both.

It is true, Mr. President, that if we are to have fish food in the future for the common people, that we have got to go steadily along the line of protection to the fish that are planted. I shall have a little something to say hereafter, on that question, if I have an opportunity to read a paper, but it seems to me that the American Fisheries Society, which is composed of a body of men who are students and teachers throughout the country, should not be afraid to put itself on record, fairly and squarely, on this proposition. (Applause.)

President: Allow me to say one word: A resolution of this scope must invariably affect some states perhaps unfavorably. Now take my own state. If this resolution comes to me, the Governor would send for me and say, "Mr. Root, what do you want?" I would have to say, "Governor, I don't want anything." This is the action of the American Fisheries Society. It will not apply to our state. We have got all the laws for the protection of fisheries, to prevent pollution of water and everything of that kind, that we need." Now there is a case where the action of your committee would not amount to anything; but it is a small state and we can take care of it.

The trouble is, gentlemen, you have not started early enough. Each state should take hold and push this matter. Do you think this resolution will help you in pushing it? It won't help us in Rhode Island. We have the best laws that we can enact. The question is before you for adoption.

The resolution was unanimously adopted by a rising vote.

Mr. Meehan: That concludes the report of the committee on resolutions.

Mr. North: Is it in order for the report of the committee on location and time of meetings?

President: Yes.

Mr. North: The committee received applications from Denver, Colorado; Detroit, Michigan; Erie, Pennsylvania; and Grand Rapids, Michigan. But we could hardly resist the silent voice of our future president, Mr. Joslyn. Although the finan-

cial perquisites that we were expecting, did not seem to materialize (laughter) yet the committee decided in spite of that fact, to meet in Grand Rapids, Michigan, in July of next year, during a time corresponding to this week, the same days, Tuesday, Wednesday and Thursday. (Applause.)

Mr. Meehan: Although, as head of the delegation from Pennsylvania, I am disappointed in the decision, I would move the adoption of this report.

Motion seconded. (Applause.)

Unanimously carried.

Mr. Seymour Bower: As a member of the committee on resolutions I have a resolution to offer. It is not presented by the chairman, for the reason that he rather dissents from a part of it. It is a majority report, however, and although Mr. Meehan voted against a part of it, we hope that it will be adopted.

Whereas, The Hon. W. E. Meehan, Commissioner of Fisheries of the Commonwealth of Pennsylvania, during the past and present meetings of this society has contributed greatly to the interest and value of our meetings, by his zeal and devotion to its interests, and to the attendance by bringing to our annual gatherings a large delegation of his associates; therefore,

Resolved, That the sincere thanks of the society be and are tendered to him for his earnest efforts to advance the interests of the society, and we recommend him as a worthy example to be followed by the commissioners and fish cultural authorities of all other commonwealths.

Resolved, That all that has been said in commendation of the actions of Mr. Meehan is repeated in behalf of Commissioner Root and his associates of the Rhode Island Commission, and the thanks of this society are hereby tendered to the commissioners of that state.

Resolution put by Mr. Bower and unanimously adopted.

Mr. Fullerton: Mr. Bower has said that he had had prepared a comparative of the progress in egg and fish output during the last eight years, and I move that that statement of Mr. Bowers be put in to the next annual report, if he is willing.

Motion seconded and unanimously carried.

The report is as follows:

COMPARATIVE STATEMENT

Of the Total Output of the Bureau of Fisheries for the Years
1899 to 1905, Inclusive.

Year.	Eggs.	Fish.	Total.
1899.....	64,956,000	991,415,898	1,056,371,898
1900.....	88,682,000	1,075,654,754	1,164,336,754
1901.....	150,307,251	1,023,526,211	1,173,833,462
1902.....	198,672,200	1,296,871,174	1,495,543,374
1903.....	182,238,373	1,043,819,102	1,226,057,475
1904.....	263,123,354	1,004,219,671	1,267,343,025
1905.....	395,972,755	1,298,030,857	1,694,003,562

President: A vote of the executive committee empowering Dr. H. M. Smith to represent this society as a delegate at the International Fisheries Association in Vienna was passed, and credentials forwarded to him. He did not receive them in time to present to the Congress, but nevertheless we regard him as our delegate to that international congress. We want to hear some report from him, and I will take the liberty of calling on Dr. Smith to make a report regarding his visit to the international Congress.

Dr. H. M. Smith then presented a paper on the subject of "The Third International Fisheries Congress."

Dr. Smith's paper was referred to the committee on resolutions for the purpose of having a suitable resolution prepared regarding the acceptance by the International Fisheries Congress of the invitation to meet in the United States in 1908.

Mr. Meehan: I would like to have opportunity to express on behalf of myself and my associates my heartfelt appreciation of the resolution which was adopted by this society. It is a pleasure to me, and it is a pleasure to my associates to be present and do what we can to further the interests of this society. While the Department of Fisheries of Pennsylvania requires its superintendents to be present at these meetings, I wish to say emphatically that no order is really necessary, for there is not a superintendent in the employ of the Pennsylvania Department of Fisheries, who, I believe, would not be present of his own volition, even if he were not ordered.

(Applause.)

President: I suppose I ought to say a word in regard to Rhode Island. When we first joined the American Fisheries Society we thought of sending a delegate, or two delegates. Well, I was opposed to that, because I thought they might leave me out and I wanted to come (laughter), and I told them we would all go, and we all did. (Applause.)

The auditing committee presented the following report:

REPORT OF AUDITING COMMITTEE.

This committee has examined the accounts of the Treasurer and find the same to be correct and in accordance with his report, which is therefore approved.

ROBERT K. ROBINSON,
N. R. BULLER,

Committee.

Unanimously adopted.

Dr. Evermann then read a paper by Mr. Leon J. Cole, on the subject of "The Status of the Carp in America."

Dr. Smith then read a paper by Dr. S. P. Bartlett of Quincy, Illinois, on "Carp as seen by a Friend."

Mr. C. D. Joslyn of Detroit, Michigan, made an address on "The Policy of Ceding the Control of the Great Lakes from State to National Supervision."

Mr. Nathan R. Buller of Pleasant Mount, Pennsylvania, then read a paper on the "Propagation and Care of Yellow Perch."

Adjourned to same day and place, 2:30 p. m.

AFTERNOON SESSION.

Thursday, July 27th, 1905, 3 p. m., same place. Meeting called to order by the president.

Mr. Clark: I would like to ask leave to have the paper on "Pacific Salmon Eggs," by Mr. Ward T. Bower, printed in the proceedings without reading. Mr. Bower has been called away and cannot present his paper.

Consent given.

Mr. Clark: I move that Mr. Fullerton's resolution regarding the cession of the control of the Great Lakes fisheries to the general government, be taken from the table.

Motion seconded and carried.

Resolution reread.

Motion made and seconded that the resolution be adopted.

Mr. Meehan: I would like to ask one question before that is done. Do the efforts of Representative Shiras referred to, cover fish alone or only game?

Mr. Fullerton: I suppose everyone as well as myself has read of Representative Shiras and his efforts to get a federal law passed to protect migratory birds in their flights to the north. He switched on that during the last session and has now a bill in preparation in regard to fish. What has drawn my attention to it particularly is a discussion in the American Field, between Mr. Shiras and a California judge, as to the constitutionality of the law. But the probability is that the law is constitutional. The bill proposes that the United States take the control of the Great Lakes bordering on the states and Canada, and also on interstate waters bordering on the states, such as the Mississippi river, in which we are greatly interested, between Wisconsin and our own state, and that we may not only plant fish there, but protect them by national legislation. The purpose is to have a uniform law that fish shall only be taken in certain seasons, only be taken of a certain length, and by certain means. That is the purpose of the Shiras bill, and that is why I submit this resolution to the society here to get its endorsement, because I believe it is one of the most vital things that can come before the society, that is, the protection of the fish in our Great Lakes, and also in interstate waters. We can never get two states together, let alone forty, to pass the same laws. Minnesota may have one law regulating fish, Wisconsin another, Michigan and Iowa and the Dakotas another, and when such conditions as that exist it is pretty hard to do anything in the line of fish protection. Our only salvation is in having congress take hold of the matter, and when that is done the problem will be solved.

Mr. Joslyn: I do not like to take up any time, but while I have been away I have been thinking of that resolution a little.

and I do not know whether it is exactly right or not. I offer a suggestion to you to see what you think about it. The legal phase of this question has been sharply before us in Michigan, as many of you are aware. A little friction sprang up between the state game warden and the federal department in which the warden undertook to seize the federal men and their nets while they were out fishing for whitefish and lake trout from which to take spawn. An application was made to the Federal Court at Grand Rapids for an injunction restraining the game warden from proceeding further, the game warden claiming he had a right to do this under the state law. The United States District Court granted an injunction against the state game warden and the case is now before the Court of Appeals. The Michigan Fish Commission realizing the serious trouble and the serious injury that was being done to Michigan by this friction, appealed to the parties to let that case wait for a while and see if we could not get legislation that would end the trouble. Last winter the legislature of the state of Michigan very promptly remedied the difficulty by giving the United States the power to take fish without the superintendence or interference of the state authorities. Now when we first talked with different members of our legislature, we found some of them had a serious prejudice against giving federal control, yet after looking the situation all over they readily came into line. And the thought that occurs to me now is whether we should not broaden this resolution sufficiently to memorialize each state legislature in regard to it and ask them voluntarily to cede the control and not leave the question open to future litigation which is sure to arise in some state if this congressional action is taken.

Now I looked into the legal question quite a bit while I was up in Michigan. My own judgment is that congress has this power. In the case of the Commonwealth of Massachusetts vs. Manchester, which arose some years ago, a portion of this very question was before that court. But the court dodged the question and it went off on some other point, but expressly reserved the question which is before us now for future consideration. It stated that inasmuch as congress had not passed any legislation it was clear that the state authorities were supreme, leaving it open for the future to see what would happen after congress had

taken just such action as is proposed by this resolution, and the action proposed by Mr. Shiras of Pennsylvania; and so thinking it all over I have wondered whether or not we ought not to broaden this resolution so as to get the state legislatures in action also. I do not offer an amendment, but offer a suggestion for you to think about.

Mr. Fullerton: I think that is in the resolution.

Mr. Clark: I do not think so.

Mr. Joslyn: I think it merely calls the matter to the attention of our members of congress, but I think we ought to get after our state legislatures.

Mr. Meehan: I think Mr. Fullerton is right.
(Resolution read.)

Mr. Joslyn: I believe that resolution is all right.

Mr. North: Would it not be well to put in there that they cede their rights as far as fishing is concerned?

Mr. Clark: It is not necessary. They have not any other rights in the waters except the fishing rights.

Mr. Meehan: I think they have.

Mr. Fullerton: Not in the Lakes. Congress regulates the commerce of the Great Lakes.

Mr. Joslyn: Within the three mile limit I think it is within the state jurisdiction.

Mr. Clark: Then there is a little loop-hole there—nothing is said about fish.

Mr. Fullerton: I am willing to have the resolution changed by inserting the words "fisheries of the" before the words "Great Lakes" where they first occur.

Mr. Worth: I would like to ask the question whether the committee that drew the resolution intended that to apply only to rivers lying between states, or to include rivers which cross a number of states?

Mr. Meehan: That would cover the Delaware and Missis-

sippi—there is no doubt about that—and I should like to see it, so far as our boundary rivers are concerned, enforced.

Mr. Fullerton: We have had a game warden in Minnesota arrested for kidnapping, by the Wisconsin authorities, which is a penitentiary offense in Wisconsin, punishable by a maximum imprisonment of fifteen years. Our warden arrested a man for fishing over an imaginary line on the ice; and they lay for the warden, arrested him, and brought him to Wisconsin and tried him for kidnapping. We had hard work to get him off.

President: If there is no objection, the words suggested will be introduced into the resolution.

Mr. Meehan: Then the resolution which we offer will read as follows:

Resolution offered by Mr. Fullerton of Minnesota, and signed for report by the resolutions committee:

Resolved, That the American Fisheries Society, assembled at White Sulphur Springs, at this thirty-fourth annual convention, wish to heartily commend the efforts that are being put forth to have the different states cede to the National Government any jurisdiction they may have over the fisheries of the Great Lakes and interstate water forming the boundary between said states. And be it further

Resolved, That this society most heartily commends the efforts of Representative Shiras of Pennsylvania in his efforts to secure the passage of a federal law regulating the fishing on the Great Lakes forming a boundary between this country and Canada. And be it further

Resolved, That this society pledges its membership individually and as a society, to get their respective Congressmen and Senators committed to the support of this measure.

The resolution was then unanimously adopted.

The committee on resolutions then presented the following supplementary report which was unanimously adopted.

Whereas, The American Fisheries Society in annual convention assembled at White Sulphur Springs, West Virginia, has learned of the action of the International Fishery Congress in

designating Washington, D. C., as the place of meeting for the next congress; therefore

Resolved, That this Society hereby expresses its gratification at the honor thus conferred on the United States by the body of distinguished foreign authorities composing the late International Fishery Congress.

Resolved, That we pledge our individual and united efforts to promote the success of the Washington Congress, and will accord all practicable assistance and support to those having charge of the arrangements.

Resolved, That at the proper time the President appoint a committee of seven members to officially represent the society at the Congress; the said delegates to represent the different geographical sections of the country as far as practicable.

Resolved, That the Society hold its regular annual meeting at Washington in 1908, in conjunction with the International Fishery Congress.

Mr. Townsend: Would the two meetings of this society be held on the same day as those of the International Congress?

Dr. Smith: It may be desirable to hold an individual meeting a day or two before, or it may be desirable to merge your meeting with that of the greater body. A business meeting of our Society will certainly be required.

Mr. Charles H. Townsend of New York City then read a paper on the subject of "How Can the Home Fish Pond be Made Productive."

Mr. W. E. Meehan then read a paper written by Mr. S. W. Downing on the subject of "Collecting, Hatching and Distribution of the Pike-perch: Why the Great Loss of Eggs."

President: We have three more papers, one is by Mr. Worth who wishes to have it carried over to the next meeting.

The other two we will have read, and Dr. Smith has been requested to occupy your attention for a few moments on the subject of sponges.

Dr. W. E. Meehan, of Harrisburg, Pennsylvania, then read a paper on the subject of "Frog Culture."

Dr. H. M. Smith spoke on "Sponge Culture."

Mr. Joslyn: Before we adjourn, may I have a minute of the time of these gentlemen here? I desire to say in behalf of Michigan, and in behalf of the city of Grand Rapids in particular, that if you will only come there next year, bring your friends, your wives, your cousins and your aunts, and tell all the people who are interested in fish culture, whether members of this Society or men whom we desire to have members of the Society, to come to Grand Rapids, we will give you and them the time of your lives.

The city of Grand Rapids, though not my own city, I can say to you confidentially, is one of the liveliest hustling cities in the west, with a population of 125,000 inhabitants, good hotel accommodations all over the city, at any price you desire.

If you take a street car in front of almost any hotel, in twenty minutes you will reach one of the oldest, and we take pride in saying we believe the best, bass hatcheries in this country, and it is under the charge of our friend Lydell, and that is something in its favor, as you will all agree.

The managers of the two railroads have said to me that if we got the Society there, they would give us cars and a train at any hour that might desired, to take the Society to the Paris Trout Hatchery, which is our oldest trout hatchery, and we can put a train of cars at your service to go to and from that hatchery and back to the meeting. I may say to all those who come from the east, you will probably pass through the city of Detroit, and at the city of Detroit we have the fish hatchery which now is under the charge of the United States. Twenty-seven miles away we have the United States Trout and Bass Hatchery, under the charge of Mr. Clark. You can take a trolley car and in a short time reach that hatchery. We can thus give you the benefit of the hospitality of the two cities, Detroit and Grand Rapids.

In Grand Rapids is a Sportsmen's Association of over 300 men, containing such members as ex-Senator Patton, and a large number of other men like him, every one of whom has extended in writing an invitation for you to come there, and I want to say to you that that association of sportsmen will make it busy for you when you get to Grand Rapids. We want you all to come and have a good time, and we are going to undertake,

on the part of Michigan to make the next meeting of the American Fisheries Society the best on record.

(Great applause.)

Mr. Clark: May I also voice a few words in regard to the Society coming to Michigan next year? Being one of the oldest members of the Society, and possibly the oldest member present at this meeting, it does me good to think that you are coming to Michigan. There is one thing that Mr. Joslyn left out.

Mr. Joslyn: I left out a lot of things.

Mr. Clark: One thing in particular comes to my mind. He does not say anything about the world's finest trout streams which are in Michigan, so made by the work of fish planting. There are millions of trout in those streams that are longing to be caught by members of the American Fisheries Society, and on behalf of the trout in the streams of the State of Michigan I thank you for selecting Grand Rapids as the place of your next meeting.

(Applause.)

Mr. Lydell: Although Mr. Joslyn has extended to you the hospitality of Detroit, do not forget Mill Creek.

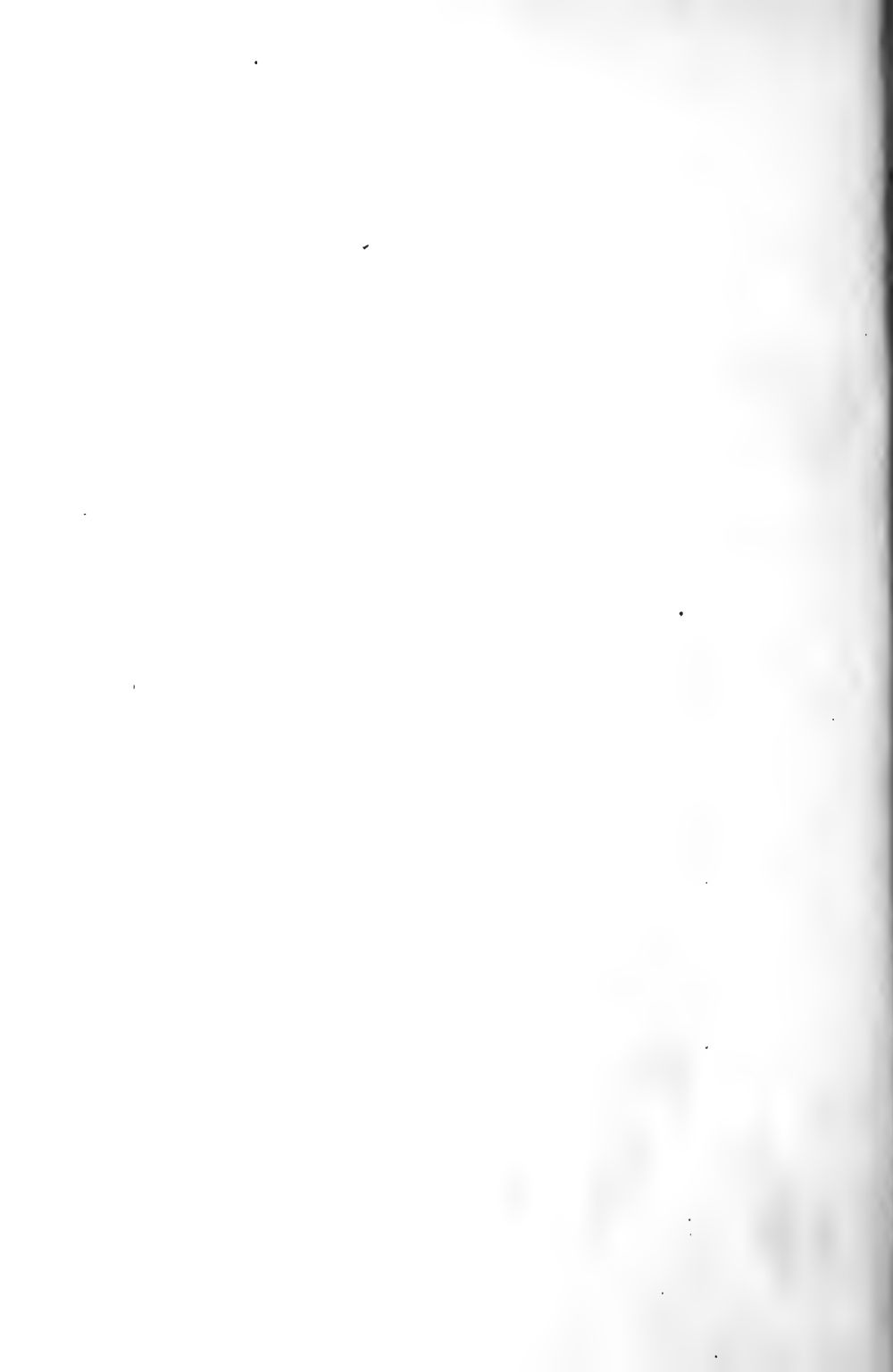
Mr. North: I move that a vote of thanks be extended to the retiring president and the officers of this Society, all of whom have worked untiringly and with great effect to promote its success.

Put by Mr. North and carried by a unanimous rising vote.

Adjourned sine die.

PART II.

SCIENTIFIC PROCEEDINGS.



SALT SOLUTION AS AN AID TO FISH CULTURE.

BY HENRY O'MALLEY, OF BAKER, WASH.

The floating properties of the salt solution first attracted my attention while using it to clear up eggs which had been removed from the spawning beds of salmon to ascertain whether or not they contained embryo. Later on the knowledge that Mr. McNaughton of Roy, Washington, had an egg-picking process for sale suggested the question: "Why cannot good and bad eggs be separated through their difference in weight?"

The first experiments were conducted with eggs of the quinnat salmon, a limited number of good and bad eggs at 450 temperature units stage of development being placed in a solution of equal parts of salt and water with the result that all the eggs floated. Water was then added and a solution of one part salt and nine parts water formed, at which point the good eggs slowly separated from the bad ones and settled to the bottom. The bad eggs remained on the top only a minute to a minute and a half, but there was ample time to remove them with a net. Later eggs of the blueback salmon were tested with similar results, but as the loss on this species is always very small, experiments were not extensive. Ten million silver salmon eggs were then tested and the greater portion of them were subject to the solution with absolutely no harm and with a great saving in time over the old method of picking eggs by hand.

In order to ascertain whether or not the salt solution is harmful, eggs at 449 and 490 temperature units development were placed in a one to six solution and held for ten minutes. When removed they were indented, had the appearance of eggs in a shipping case that had become too dry, and in a few instances the main artery or vein seemed distended near the heart. After remaining in the water some few days, however, this distention disappeared and the eggs hatched without loss. The resulting fry did well up to the time of feeding, and when liberated they were strong and healthy. A solution one to seven was tried in the same manner with similar results. The solution one to nine was now tested and at the end of ten minutes no change had

taken place, but at the end of fifteen minutes the distended condition appeared but as in the case of the one to six solution it disappeared in a few days with no apparent harm to the fry. The eggs were subjected to the solution only once. This solution has been used with equally good results on eggs of the dog salmon and steelhead trout.

The salt solution is an aid to fishculture in other ways not previously recorded. It enables one to distinguish the dead and unfertilized eggs at an early stage of development. To do this the basket should be immersed one minute in a one to twenty solution and then returned to the trough. Within an hour all empties will have turned white. The danger of rupturing the embryo, which is liable to occur by the old method is thus eliminated. Thus one can clean up very young eggs for shipment with very little handling.

In using this process the solution was held in a water tight box or trough of one inch lumber, 40 inches long, 18 inches wide, and 12 inches deep. Inside this was a second box of one-half inch lumber, 3 inches less in width, 3 inches deeper, and provided with handles and a screen bottom. A net or scoop made of basket wire was used for removing the dead eggs. The trough or box was filled to within a few inches of the top with water and salt gradually added and dissolved until the proper density being determined by taking a small portion of the solution in the graduate and testing it with a few good and bad eggs each time the salt was added. This was found to be the most satisfactory method, as salt readily absorbs moisture and varies in purity, thus making it difficult to get it correct by weight or measurement. The box with the screen bottom is placed in the solution, wedged down, and a full basket of from 35,000 to 60,000 eggs is poured into the inside box. In less than one minute the good eggs have settled to the bottom and the bad ones can be removed with the wire scoop. The inner box can then be lifted out and the good eggs returned to the basket and fresh water, the whole process not requiring over three minutes. One solution can be used over many times by adding sufficient salt to maintain a uniform density.

The box or trough was adopted because of convenience in handling, and on account of its furnishing the necessary amount

of surface, a very important feature to be considered, as the bad eggs if crowded, would cause the good ones to float by mingling with them.

Quite an extensive use of this method has shown no deleterious effects, and where there are over a thousand dead eggs in the basket at the time the empties are turned the use of the salt solution will result in a saving of labor.

DISCUSSION.

Mr. Whish: This is an entirely new suggestion, so far as I am concerned, and if, as suggested by Mr. Titcomb, this method can be applied to brook trout eggs, we can save much time and labor in our hatcheries. If Mr. Clark has had any practical experience with it in handling lake trout eggs, I should like to hear from him, because we have been paying particular attention to lake trout during the past two years, in our state, and will pay more attention hereafter. If we can save time and labor, it will be of great value.

Mr. Clark: I am perfectly willing to give my experience with the salt solution, as far as I have gone. I have not however, done enough to arrive at any positive, definite conclusion.

I really think it is of no value whatever so far as lake trout and brook trout are concerned, and I will give you my reasons. But still, as I say, it may be that I might change my views after another season's work with the lake trout. In order to be valuable it must do the work before the eggs are at 450 temperature units development; because at that time it would take longer to pick the eggs out of the trays in the troughs or baskets, (if you hatch them that way), and prepare, put them in the solution and wash them up, than to handle the trays and pick the eggs out. But at that time there is not one per cent of bad or unfertilized eggs in the tray. So unless this method can apply before what we call the eyed stage, with 400 and over temperature units, we cannot use it with lake trout.

I know from the experiments that we could do nothing with this method in what we call green eggs—the bad eggs would not rise. That is why I say, as far as I have gone, it is of no value to us, because after the eyed stage it will take more

time to get your eggs off the trays into the tub, pan or whatever you may have your solution in, and put them back again, than it will to handle the trays and pick out what is necessary.

With brook trout, according to our experiences, it will not work on green eggs; with the eyed eggs it is not advantageous to use the process. We get, for instance, from the commercial fisherman, 95 to 99 per cent of good eggs, as we receive them. Now it is of no value there, because those eggs can be picked out by hand quicker than you can empty them from the trays.

As I understand it, with salmon, when they are prepared for shipment, there are more or less fertilized clear eggs.

Mr. Titecomb: Yes, when you can barely see the eyespot.

Mr. Clark: As we are handling lake trout at Northville to-day, when you can barely see the eye spot, they are over 60 days old, in our colder water; and should we allow them to remain unpicked until that time all would be lost. If we can go over our eggs and have them sorted out pretty thoroughly when they are two or three weeks old, the principal work of the winter has been accomplished. Now, with our 40,000,000 lake trout eggs at Northville, had we allowed them to go until the time that the salt solution would be available, we would have one great mass of dead eggs. The salt solution method would be a saving only if we could apply it to eggs one or two weeks old. It cost us last winter probably \$700 to \$900 for help to sort out the dead eggs from 40,000,000 lake trout eggs. Could we use the salt solution method before the eggs had become eyed, it would be valuable.

Mr. Titecomb: Have you ever tried salting your eggs as you would salt fish, in order to avoid fungus—green eggs?

Mr. Clark: No sir. I do not think the question of fungus is anything we need bother about. I do not think you should allow these eggs to remain in the troughs on the trays, even if they have not become fungused.

Q. What is the objection?

A. I think there is something that comes off the dead eggs that should not be left in the water with the other eggs.

Q. You did not try it on brook trout?

A. We tried it on eyed brook trout.

Q. Did it work?

A. No.

Q. It would not raise the dead ones?

A. No sir.

Q. Did you try a number of solutions?

A. Yes.

Mr. Titcomb: I have seen eyed brook trout eggs come in from field stations when half of them were dead.

Mr. Clark: I am unable to see why they should be that way.

Q. You have not operated field stations with brook trout eggs, have you?

A. Oh, yes, I have.

Mr. Titcomb: Of course the conditions vary, but there are field stations where you cannot get all good eggs, I do not care how well the matter is handled.

Mr. Clark: Do I understand, Mr. Titcomb, that eyed eggs have come from the field station and 50 per cent of the eggs were dead after they were eyed?

A. No, the eggs were not dead, they were unfertilized eggs.

Q. They were white, were they?

A. They turned white in transit.

Mr. Clark: Why were they not allowed to turn before being shipped?

Mr. Titcomb: They cannot sometimes stop to do that, where they are handling millions of brook trout eggs at a field station, with probably only one man to do the work.

Mr. Clark: Of course, if there is not help enough it is a different question.

Mr. Titcomb: There is no object in it if you can take them to the main station in that way and revive them with salt solution.

Mr. Clark: Yes, if your salt solution will work.

Mr. Titcomb: I would like to see the problem worked at by different fish culturists. There must be a difference in specific gravity between live and dead brook trout eggs, just as there is between live and dead common eggs, and a test with different solutions ought to disclose a solution by the use of which the dead eggs would rise to the surface and separate themselves from the live ones.

Mr. Clark: I am not prepared to say that I have made experiments far enough in this matter to speak decisively. We should like to have the problem solved if it will help us out on the lake trout question; but with us the brook trout is a comparatively small matter. But if it won't work on the green eggs, I cannot see the value of it: unless shipments come in from the field containing unfertilized eggs, and they change their color enroute, and are ready to be removed upon arrival.

Mr. Titcomb: There is one condition that prevails in salmon work that does not prevail in the trout work. The salmon eggs all being eyed and placed in the baskets, say three inches deep, a solid mass of eggs; while Mr. Clark would have that same number of eggs in probably half a dozen trays, one on top of another.

Mr. Clark: Three trays.

Mr. Titcomb: An inch deep of eggs on each tray.

Mr. Clark: Practically, yes, aside from the size of the trays.

Mr. Titcomb: How many layers of eggs to the tray?

A. They are full.

Q. About three layers of eggs?

A. They are full, about three layers.

Mr. Ward Bower: I do not consider the use of the salt solution to be practical in the handling of quinnat salmon eggs,

judging from what I had to do with the experiments at Battle Creek station, California. I think it is of much greater importance to get better eggs so that there will be but few bad eggs to be disposed of. A salt solution has to be absolutely correct, one to nine, or it will not work. I tried it several different days, and the first time happened to get it exactly right. The next two days it would not work with a solution supposed to be one to nine, but which upon investigation I found to be about one to nine and a quarter, and with even this would not work. The eggs should be at least 350 temperature units in development in order to make the plan of use; because they will not stand the handling much earlier. The loss would be great if they were handled at only 200 to 300 temperature units of development.

Mr. Clark: Have you tried earlier stages of the eggs; for instance, have you tried from 375 down to 300 temperature units?

Mr. Ward Bower: No sir, it was not tried with anything under 350 I think, to be exact.

Mr. Clark: And did the eye spot show then?

A. Yes.

Q. Had there been any eggs picked out previous to that?

A. They had been picked every day, with the exception of two or three days during the real critical stage of development and I consider it essential that they should be handled every day. By this course we have reduced the percentage of loss from twenty to two and one-half per cent.

Mr. Titcomb: Could not you apply the salt solution right in the box, by shutting off one compartment?

Mr. Ward Bower: I do not think there would be room. Of course the hatching troughs in use there are just the plain troughs. There are no compartments in them, just plates that spring in.

Q. Sheet iron?

A. They are sheet iron. Those at the Baird station are made of steel about one-twelfth of an inch thick, but they

do not seem to be as good as those made of number 22 galvanized iron, sprung into position. In the others the steel has to drop into a slot and often sticks; while the other springs in and is much more convenient and easy to use.

Mr. Titcomb: In connection with this point on which Mr. Ward Bower has touched, the importance of attempting to fertilize as large a percentage of eggs as possible, I do not think that ought to detract at all from any attempt to make the salt solution effective, because there are certainly instances in almost every branch of fish culture, when you get a bad lot of eggs, and will have a considerable lot to pick out, or else throw the whole of them away.

PROGRESS AND EXPERIMENTS IN FISH CULTURE DURING THE PAST YEAR IN THE BUREAU OF FISHERIES.

BY JOHN W. TITCOMB, ASSISTANT IN CHARGE OF DIVISION OF FISH
CULTURE.

Perhaps the most interesting and important discovery is that of Superintendent Henry O'Malley of the Baker Lake station on the Use of the Salt Solution as an Aid to Fish Culture. His paper on this subject, given elsewhere, is self explanatory.

Tests made at other salmon stations prove the value of the discovery when it becomes desirable to remove a large number of dead eggs after they have passed the more tender stages of development. For instance, all unfertilized eggs can be removed when preparing a lot for transportation in egg cases. The experiments of Superintendent Lambson as reported by him are here given :

First. Eggs of 486 temperature units development with an equal number of dead eggs were placed in a salt solution of one part salt to six parts water. Eggs showed no signs of injury the day following.

Second. Equal numbers of good and bad eggs were placed in a solution of one of salt and seven of water. All eggs remained suspended just below the surface, and no separation between the good and bad occurred. No injury to good eggs followed the immersion.

Third. Equal numbers of good and bad eggs were placed in a solution of one of salt to eight of water. After three minutes good eggs began to settle to the bottom, after five and a half minutes all good eggs had settled leaving none but dead eggs floating, these were readily poured off.

Fourth. Equal numbers of good and bad eggs were placed in a solution of one of salt to nine of water. At the end of fifteen seconds the good eggs began to settle; in two minutes none but good eggs remained at the surface, this gave best results.

Fifth. Equal numbers of good and bad eggs were placed in a

solution of one of salt to ten of water. All the good eggs and many of the dead at once settled to the bottom.

Sixth. Equal numbers of good and dead eggs were placed in a solution of one of salt to eleven of water. All promptly settled to the bottom. Eggs left in a solution of one of salt to seven of water for five minutes show a dent in the shell and feel soft and flabby as if a portion of the contents had been expelled. They resumed their normal appearance after returning to fresh water, and suffered no ill effects. Eggs remained in a one to nine solution for seven minutes without injury. Unfertilized eggs that have not turned white will settle to the bottom in a one to nine solution as promptly as the good eggs; but will turn white shortly after they are returned to fresh water; a second immersion will cause them to float when they can be readily poured or skimmed off. All good eggs used in the experiments were over four hundred temperature units of development. After eggs have passed the tender stage, over four hundred temperature units, the one to nine solution affords a cheap and easy method of removing the dead or unfertilized eggs, but until this development has been reached it cannot be successfully used as the eggs are too tender to withstand removal from the trough and pouring into the solution. It is doubtful if this method could be applied to Baird and sub-stations as eggs are picked daily through the tender stage, to avoid the collection of fungus, and practically all dead eggs are removed before good eggs have developed to a stage where they can be placed in the salt solution without injury. By picking the eggs daily we have a loss of from three to five percent; if they were buried or covered during the tender period to permit the use of the salt solution, the loss would probably be much greater from fungus. We find that the salt solution works best when not over twenty or thirty thousand are used at one time; when more than this number is used the good eggs become entangled with the dead and are thus supported at the top and cannot be separated. As we frequently put from forty to fifty thousand in a basket it was necessary to divide the basket to hold one half while the other half was in the salt solution. I can readily see the value of this method in special cases such as an injury to a basket of eggs after they have passed the tender stage which would make it necessary to remove a large

number; also in shipping should a great number of unfertilized eggs remain in the basket. The unfertilized can be removed at the time of the packing in the cases.

Experiments were made as to the value of the salt solution in handling eggs of brook trout and lake trout without satisfactory results.

Superintendent Stone opines that the differences in the specific gravity of live lake trout eggs and dead ones is not sufficient to make it practicable to separate them by the use of the salt solution, and he adds that indications seem to show that the method will succeed with brook trout eggs.

Supt. Clark is present and you will undoubtedly wish to hear him tell the results of his experiments.

Even if this labor-saving method of picking eggs is only applicable to eggs of the Pacific Coast salmon it is still of great value.

Considerable progress has been made in the past four years in the method of taking and fertilizing eggs of the Pacific coast salmon.

An important step in this direction was when the late Cloudsley Rutter discovered the use of the normal salt solution for washing eggs before being fertilized. This was found to be very beneficial in cleaning eggs which were frequently covered with blood and filth under the old method of stripping. In the year 1904 several experiments were made by the superintendent of the Clackamas station to test the efficacy of bleeding fish prior to taking the eggs and the value of this method, if any, over the use of the normal salt solution for washing them. These experiments tended to show that the normal salt solution was unnecessary but were not conclusive.

During the past year experiments have been conducted by the superintendents of the Baird, Baker lake, and Clackamas stations and the results indicate that the normal salt solution is not necessary if the fish are killed and properly bled before the eggs are taken.

The conclusions of the superintendent of the Baird station go even farther, he having decided that the quickest and best method is to kill the fish, take the eggs by incision in the thin side wall of the belly an inch or more from the fins and fertil-

ize by the dry method without washing in the normal salt solution.

The incision is made in the thin side walls of the belly about one inch or more from the fins. But a few drops of blood follow the incision and most of it runs to the tail of the fish, and does not foul the pan of eggs. The experiments of Superintendent Lambson are of such interest that they are here given.

1. From seven salmon killed by a blow on the head 30,000 eggs were taken by hand, fertilized by the dry method, and picked until shipped, the loss amounting to ten and three-fourths per cent.

2. Seven salmon were killed by a blow on the head and bled 30 seconds before spawning by cutting off the tail; 30,000 eggs were taken as soon as the blood stopped flowing, washed in the normal salt solution, fertilized by the dry method, and picked daily. The loss to the time of shipment was one and one-fifth per cent.

3. Seven salmon were killed by a blow on the head, and 15 seconds later were bled by cutting off the tail. After bleeding 30 seconds 24,000 eggs were taken by hand and fertilized by the dry method. They were picked daily until shipped, the loss amounting to two per cent.

4. Seven females were killed but not bled, 30 seconds after killing 34,000 eggs were taken from an incision in the side and washed in the normal salt solution. The eggs were fertilized by the dry method and picked daily until shipped, the loss being seven per cent.

5. From seven salmon killed and bled after the manner described in Experiment 3, 30,000 eggs were taken by incision and washed once in fresh water. Fertilization was accomplished by the dry method and the loss resulting from the daily pickings to the time of shipment was two and one-half per cent.

6. After killing and bleeding seven salmon according to Formula No. 3, 40,000 eggs were taken by incision, washed once in the normal salt solution, and fertilized by the dry method. The daily pickings of the eggs to the time of shipment amounted to four per cent.

7. From 16 females 82,000 eggs were taken by the old meth-

od of spawning while alive. They were fertilized by the dry method and picked daily until shipped, with a loss of four per cent.

The experiments demonstrated that it is useless to bleed the fish, as practically the same amount of blood followed the incision in both cases, and as it was only a few drops no harm could result were it all to mingle with the eggs in the pan. The quickest and best method is to kill the fish, take the eggs by incision in the thin side walls of the belly an inch or more from the fins, and then fertilize by the dry method without using the normal salt solution. The washing of the eggs, as described in Experiment No. 5, proved nothing, as they were not exposed to the water over half a minute before fertilizing.

Heretofore at Baird station all eggs have been taken by hand from living fish, the objections to killing before spawning being the large loss of eggs resulting from the killing of the partially ripe fish. The new method has been found to possess many advantages over the old, resulting in the saving of both time and labor, and by exercising a little care, it is possible to see that only fully ripe fish are put into the pens. It does away entirely with the butchering of the females after the regular spawning in order to obtain the few remaining eggs—a most unpleasant work, as a profusion of blood was caused by the rupture of the small blood vessels during the regular spawning, which necessitated frequent washings in the normal salt solution before fertilization could be accomplished. Another good feature of the new method is that it obviates the necessity of a skilled spawn-taker.

The season at Baird had closed before the experiments were made, but the new method was adopted exclusively at the Battle Creek and Mill Creek stations, and in addition to the time and labor saved, the quality of the eggs was improved.

The dry method of fertilization is used entirely at Baird and substations, and as soon as possible after applying the milt the eggs are washed. When there is time they are washed until the water in the pan shows no trace of milt, but if there is a large amount of spawning they are put through several changes of water only before being transferred to the spawning buckets, and in this case the water in the pan is slightly milky. The

eggs are placed in ten-gallon buckets—from 40,000 to 50,000 to a bucket—and allowed to remain absolutely quiet until they become free. This precaution is necessary, as they are very tender during the adhesive stage.

Formerly it was the custom to build the spawning and the washing platforms adjoining each other, but now the washing platform is placed at a distance from the other, and the loss in eggs ranges from five to ten per cent less.

Directions were issued to the superintendent on the Pacific Coast to examine the spawning beds of salmon, to ascertain if possible the percentage of fertilization under natural conditions. The superintendent of Baker Lake station secured 355 eggs of the blueback salmon from a spawning bed in the upper Baker River, and out of this number 51 were found to contain embryos. Later in the season he visited the same beds but was unable to secure eggs, many of the beds being covered to a depth of from one to three feet, with sand and gravel which had washed in upon them during high water and after the fish had spawned.

The reports from the superintendent of Clackamas and his assistants at the various field stations are somewhat conflicting, but the general inference is that a large percentage of eggs are fertilized and that only a small percentage hatch. Superintendent Wallich describes his observations of a male salmon in the act of emitting milt on a large spawning bed with many other salmon of both sexes. He continues by saying "The milt seems to come out like a flash and almost instantly spread out covering an area of from one half to one yard in diameter. It produced a pronounced milky hue which vanished rapidly as it floated down stream and became still further minutely divided.

Since that time I have never observed a male and female in the successful act of natural propagation, though I have observed female salmon many times in the evolutions that tend to relieve them of their eggs."

The superintendent of Baird station feels that a larger percentage of eggs were fertilized than the reports from the Clackamas station show. It is believed that the report of his observations will be of interest, and it is as follows: "The clean gravel or stones in the bottom of the creek, usually called the nest or bed, is the point where the female deposits her eggs. It

is not cleaned off prior to the deposit of the eggs but during the efforts of the fish while spawning. The gravel and small stones are also loosened at the same time and carried down stream where they form a mound or ridge a few feet below the point of deposit. This ridge probably plays a very important part in the fertilization of the eggs by causing them to collect in the water just in front. As soon as the eggs are deposited they drift down stream over the bottom and come to rest in front of the ridge. In spawning the female moves up to the place of deposit, turns on her side, and with a flopping motion ejects a portion of her eggs; she then moves off and the male takes her place and ejects a portion of his milt. By the time the milt is ejected the eggs have drifted down stream to or almost to the mound. The milt is also carried down stream and is brought to rest at the mound, where it comes in contact with the eggs. If the eggs did not collect at the ridge very few would ever come in contact with the milt, as the current would carry the milt away before it was thoroughly mixed with the water. As the female deposits but a small portion of her eggs at a time, and the spawning extends over a period of several days, each time she deposits her eggs more gravel and more sand are loosened and drift down to the mound, covering the eggs previously laid and usually killing them. Practically all the eggs on the several nests examined were just in front of the mound or ridge; some were lying in plain view upon the bottom and were picked up in small skaff nets. They were very young, still slippery, and had evidently just been deposited.

By moving the gravel in front of the ridge other eggs were uncovered, which in most cases had passed the slippery stage. Practically all of the eggs thus uncovered were dead when found, having been killed probably by the gravel washing upon them while in the tender stage or smothered by not getting a current of water. A few eggs were found behind the ridge, having evidently passed over the top.

The rate of fertilization was much better than had been expected, at least fifty per cent, but practically all were dead when found.

The small increase from natural reproduction is very likely due to the high rate of mortality after fertilization, and not to

imperfect impregnation. Eggs of widely different degrees of development were found, indicating that the place had previously been used for spawning purposes by other fish, or that they had been carried down stream from above, the former probably being the case. No indications of mating or pairing were noticed, the female spawning with any male that appeared upon the scene at the time, and the males running from one bed to another and spawning with several females. The males will fight off others that come around the spawning bed, but while he is chasing them another male will frequently spawn with her. If a female was driven from the nest she moved off a few yards and spawned in another place without making a nest, but as soon as we moved away returned to the original place. An employee of Battle Creek station states he has found eggs under two feet of gravel, all dead of course. This depth of gravel was doubtless due to high water though some of it may have been deposited by spawning fish.

The number of fry hatched from the eggs thus deposited is believed to be not over two percent."

EXPERIMENTS IN TRANSPORTING EGGS.

In connection with the Craig Brook Station, Maine, Superintendent Atkins conducted some experiments in the transportation of salmon eggs long distances in a critical stage of development. At Sebec Lake eggs of the landlocked salmon to the number of 10,000, varying in age from 6 days to 21 days, were packed upon wire hatching trays on which they were resting in the hatchery, by padding them between the trays and around them with moss so as to prevent jars, and in this way they were brought safely through to Craig Brook.

In January 1905, in a shipment of salmon eggs to the upper Penobscot, several shallow boxes were filled with eggs in masses, lying at least four deep, and no bad results followed. In one instance, such a mass of eggs lay at the bottom of the package and became frozen on the way, the bottom not being as well protected as the top and sides. Enough water had settled in among them to form a little cake of ice, in which the eggs were imbedded; such a cake of ice was kept by itself, and as it thawed it released 65 eggs. These finally hatched, every one of them, and

the loss on the fry up to the time of liberation was only five fish out of the 65. Probably, though, the eggs themselves were not actually frozen.

NOTES ON POND CULTURE.

Science has been of practical assistance to fish culture through the important pathological investigations of Mr. M. C. Marsh on fish diseases. It has been found that fish diseases are frequently due to abnormal conditions of the water supply caused by supraeration, lack of aeration, or the presence of obnoxious gasses. Reference is had more especially to the investigations of the diseases of the trout.

Another opportunity for the scientist to render practical aid to the fish culturist is in that branch termed Pond Culture. To a certain degree is involved the question of normal water aeration, in the lack of which has been found the cause of diseases among trout.

The importance of aquatic plants in pond culture and their value as oxygenators is well known. Valuable papers have been written relevant to the subject—notably one by Mr. C. K. Green at the last meeting of this society. From six to ten species of well known aquatic plants are regarded by all pond fish culturists as especially desirable. During the past two years endeavors have been made to collect specimens of all the aquatic plant life at the various pond cultural stations. The superintendents have reported the relative value of each so far as known; of what specific use the desirable ones are, and the objectionable features of the obnoxious ones. This work has developed the fact that some of the common aquatic plants are not of the same subspecies at all of the stations and the kinds of plants most valuable at one station are not so highly regarded at another. A fairly desirable plant at one station may become an obnoxious weed at another because of its dense and exuberant growth. The various subspecies of one genus are not of equal value. For example, it has just been called to my attention by Superintendent L. G. Harron that a species of *myriophyllum* not heretofore used in the aquarium or in fish ponds at Washington, D. C., is more desirable than the common form because it holds its foliage from the root to the top of the stem. Identification is await-

ing a blooming specimen. The plants which are valuable in pond culture are desirable for introduction into waters resorted to by the anglers. They want to know if the ponds in which they are interested are lacking in fish food, aeration, shade, etc., and what aquatic plants, if any, are respectively qualified to remedy the defect. The public as well as the fish culturists, therefore, are inquiring about such matters. The field for study is a broad one. Some plants are food producers, are valuable for shade as well, and some are especially useful for oxygenating the water. To identify all the desirable and obnoxious aquatic plants commonly found in ponds; to ascertain the specific value or objectionable qualities of each; last, but not least, to ascertain just what plants are oxygenators and to what extent, is an important work which the fish culturist must surrender to the scientist, or more specifically, to the plant physiologist.

At each of the pond culture stations records are being kept of the number of breeders to each pond and the results in the number of young fish for distribution. The object of these records is to ascertain what number of brood fish of the various species can be carried with most economical results in ponds of a given area and depth; also to ascertain of what area and depth ponds should be constructed in order to produce the best results. The experiments cannot be brought to a conclusion in one or two years, but eventually each superintendent should be able to stock his brood ponds with a knowledge of what number of fish in each will produce the most satisfactory results. The planning of future pond culture stations can be based upon the knowledge thus gained.

The use of copper as an algicide and disinfectant in water supplies, reported by Messrs. **George T. Moore** and **Karl F. Kellerman** of the United States Department of Agriculture (Bulletins 64 and 76), led them to laboratory experiments in order to ascertain the maximum amount of copper sulphate which can safely be used in water containing fish of certain species.

The matter was then taken up by the Division of Fish Culture to determine, first, whether the application of copper sulphate in proper dilutions to destroy algae would produce any deleterious effects if administered shortly before the spawning of large-mouthed black bass, as well as its effects upon minute

aquatic life upon which the young bass feed. Two small ponds at the Fish Lakes station were selected and six bass were placed in each. The sulphate in the proportion of 1 to 5,000,000 was introduced in one of them on April 22.

A roily condition of the water unaccounted for prevented observations of the nesting bass and the date of spawning could not be obtained, but on May 8 a fine brood of bass fry was discovered, proving beyond doubt that the copper did not effect the spawning of bass.

With the disintegration of the algae there appeared myriads of daphnia.

The ponds in which this experiment was tried were of too small area to rear the fry to fingerlings, and on June 12 copper sulphate 1 to 5,000,000 was applied to a pond of 1.55 acres with an average depth of twenty and three-fourths inches. This pond was inhabited by adult large-mouthed bass fry and baby fingerlings. The latter were being seined out for distribution. By June 22 much of the algae had disappeared, comparatively little remaining. Its disintegration caused the water to impart a very offensive odor when stirred. Careful observations about the pond and of the young fish seined from it daily after the copper was administered disclosed no deleterious effects upon the young fish.

The writer was assisted in these experiments by Dr. Geo. T. Moore, the discoverer of the valuable uses of copper in water supplies, and by his assistant, Karl F. Kellerman. Some laboratory tests made by them showed the following results:

Large-mouthed black bass 100 eggs uninjured by 1 to 1,000,000.

50 one-day old fry uninjured by 1 to 1,000,000.

50 five-day old fry uninjured by 1 to 1,000,000.

25 ten-day old fry uninjured by 1 to 1,000,000.

Crappie, very young fry uninjured by 1 to 1,000,000.

Fish food is an important item of expense at stations where brood fish are carried or young fish are fed for a considerable period before distribution. More or less experimental work in this direction has been conducted at all such stations of the Bureau of Fisheries, and during the past year the work has been more systematic than heretofore. The prejudice against the use

of hogs' plucks is now largely overcome, and the cost of feeding at stations where this material has been substituted for beef plucks has been greatly reduced.

At stations where fresh food is not always available there is a demand for preserved foods. It is evident that fish need nitrogenous foods. The question arises how much waste there may be in the use of cereals, and to what extent it can be avoided. In connection with the experiments on this subject it may be necessary to examine the feces of the fish, and if the waste is quite large the fact can be disclosed by the use of a low-power glass. The extensive use of wheat middlings suggests the substitution of other less expensive grains, or vegetables. A beginning has been made by experiments in the use of cotton seed meal; meal from the germ of corn; beans; lentils; macaroni. If any combination of vegetables or cereals with meat can be found which seems to agree with the fish an analysis will be made to ascertain just what elements are most satisfactory. An analysis of the mixtures which do not agree with the fish will also be made in order to ascertain just what elements should be eliminated. It is proposed to analyze preparations which have been cooked, as well as those fed without cooking, whether composed of the same ingredients or not. Dr. H. W. Wiley of the department of Agriculture has already materially assisted the Bureau in this direction.

Mention of these experiments is here made because it may suggest new ideas to the fish culturists of this Society which will lead to successful experimental work. The field seems to be a very broad one.

In connection with food experiments it is desirable to be able to answer certain questions rather definitely, although local conditions have much to do with the subject. For illustration, it should be possible to state the cost of feeding a given number of fish of a certain species and age during a stated period. The growth should also be noted by weight. It is realized that this necessitates a long and careful series of experiments by the isolation of certain lots of fish at a number of stations.

The report of Superintendent Atkins contains some interesting data, and it is as follows:

“With the exception of a single cow-carcass, all the food

used at the station the past year has consisted of hogs' plucks bought of J. P. Squire and Company of Boston, at prices ranging from five to nine cents per pluck, or generally five cents, making a mean cost of about one and one-fourth cents per pound, or, including freight, one and one-half cents per pound. The total purchased during the feeding season of 1904, that is, from April 2 to October 31, was 24,145 pounds. Its cost in Boston was \$301.01, and, including freight, \$362.21. The food given the fry has always been recorded separately from that given to the older fish. During the season of 1904 the fry under feeding numbered 543,744 of all sorts, namely:

Atlantic salmon.....	304,490
Landlocked salmon.....	2,458
Rainbow trout.....	1,589
Brook trout.....	219,783
Scotch Sea trout.....	6,285
Steelhead trout.....	9,139

Feeding began about June 1, and between that date and the end of October these fry consumed 17,871.9 pounds of food costing \$307.09, or \$0.000565 per fish. Thus seventeen and seven-tenths fish ate one cent's worth of food, including the freight. Reckoning on the basis of the number of fish left on hand October 1, the result would be somewhat effected, but on this basis it would still appear that not far from thirteen fish were supplied with food for one cent."

Nothing has been done during the past year with the view of increasing the natural reproduction of fish food in ponds or for the purpose of producing on a large scale, live food such as minute aquatic life and insect larvae, although the importance of this line of experiments is fully appreciated.

The importance of recording failures is sometimes quite as great as the report of successes. At several stations of the Bureau attempts have been made to propagate the spotted catfish *ictalurus punctatus* without successful results. Little is known about their spawning habits, but they apparently spawn in running water on gravel or rocky bottom. Superintendent Jones of Fishery station reports that at the World's fair in Chicago in 1893 he stripped a spotted catfish and fertilized the eggs, but the

water was so warm and muddy that the eggs fungussed and perished. It may be necessary to handle these fish the same as trout or landlocked salmon, instead of by intensive pond culture. The conditions under which catfish have been held at the various ponds have not been entirely similar, and it may be well to report them.

At Fishery, Tennessee, a brood stock were retained in a pond 200 feet by 10 feet, with a water supply of about 20 gallons per minute. The fish are said to be fat and in good condition, but have not been known to take artificial food since their arrival at the station.

At White Sulphur Springs a brood stock was received January 1905, and placed in a pond about .66 acres in area, and four and one-half feet in depth at the outlet, running about eight inches in depth in the shallow parts. The bottom is made of clay and sandy soil. The water supply varies from 25 to 75 gallons per minute. The fish appear to be in very good condition.

At Wytheville a brood stock purchased from a dealer on New River, December, 1902, were first placed in a pond of about 20 feet by 100 feet, supplied with water from a spring. In April 1903, they were transferred to two breeding ponds which had been prepared for them. One of these ponds was about 40 feet by 80 feet, with a water depth of 6 inches to 5 feet, and a gravelly clay bottom. The other pond ranged from 6 inches to 3 feet in depth, and of about the same area and a meadow loam bottom. Both ponds are nearly rectangular in shape, and had a water supply of about 60 gallons per minute. The following year the fish were all placed in one pond 60 by 110 feet, with a water depth ranging from six inches to three and one-half feet. The bottom was meadow loam with some bulrushes and other plant life in the shallow bottom. The water supply was about 70 gallons per minute. During the past season the fish were planted in a pond of about 1175 square feet in area, somewhat rectangular in shape with the water depth ranging from 6 inches to 4 feet. The bottom was chiefly meadow loam, but with solid places where the top soil was removed. The pond is well supplied with plants, and the water supply averages about 100 gallons per minute. The fish have never been known to spawn.

At the Fish Lakes station 50 spotted catfish from 12 to 16

inches in length were received in good condition last January, and were placed temporarily in a pond of comparatively small area. In April they were divided into three lots and transported to as many ponds. One lot in Pond 17, so called, succumbed to heat at a temperature of 86 degrees. None of the fish have yet been known to spawn.

APPARATUS AND EQUIPMENT.

At the various stations where eggs of the salmonidae are developed it has been observed that there is no uniformity in hatchery equipment, and for various reasons a standard width of 14 inches inside measure for hatching troughs has been adopted by the Bureau of Fisheries. It is believed that the adoption of uniform measurements in all standard equipment of trout and salmon hatcheries, whether private, state or government property, would result in a material saving in the cost of construction, and also in the operating expenses.

The adoption of a standard width for troughs is a forerunner to the establishment of uniform dimensions of hatchery trays and other equipment subject to variations made necessary by local conditions. In this connection it is observed that while asphaltum paint is used for troughs and interior equipment at a majority of fish cultural stations, there are stations where the troughs are successfully used without paint, and others where lead paint on the inside of troughs is successfully used.

Experiments are now being conducted to ascertain just what material is most practicable from a fish cultural and economical standpoint. For exposition purposes, where clear water is available, the use of bath tub enamel in wooden troughs has been found efficacious, as the fish and eggs can be more plainly seen. No deleterious effects resulted from its use.

At stations where they are not constantly in use the application of bath tub enamel on the inside bottoms of rusty transportation cans has been found efficacious. In the car service, however, where the cans are almost constantly wet, the enamel soon becomes soft. Last year 500 cans with enameled bottoms were purchased; after two or three trips the enamel softened and rubbed off. An enamel or light colored paint that will stand continual moisture would be of great value for painting the

bottoms of transportation cans, not only as a preventive of rust, but also because the bright colored bottom permits the caretaker to more easily examine the fish. For the latter reason a similar material would be valuable for hatching troughs.

LOBSTER HATCHING,

The impounding of egg-bearing lobsters on the Maine coast during the winter of 1904 was so successful that this method of increasing the collections of eggs was continued during the winter of 1905 with equally good results. On the Massachusetts coast the pound is hardly worth while with the present available supply of lobsters, but experiments were made at the Woods Hole station to ascertain the practicability of carrying berried lobsters in live cars throughout the winter. A lot of 100 lobsters were divided equally between two cars 5'x4'x2'8". The cars had wooden tops and bottoms with galvanized wire cloth for sides and ends. Up to December 20 the cars were moored on the surface in the outer basin and on that date were sunk to the bottom of the harbor, one in thirty-six feet and the other in eighteen feet of water. Another lot of 300 were placed in two floating cars 15¼'x6¼'x4'8" partitioned crosswise, in the outer basin. All of them were fed regularly to the middle of December, after which date no food was given them until about the middle of March. Early in January a cold wave practically closed the harbor with ice and nothing more was seen of the lobsters until about the middle of March. In the basin where the 300 lobsters were placed the ice was over a foot thick during a part of this period. From the middle of March until April 20 food was supplied regularly. The two small cars which were sunk to the bottom showed a loss of about 25 per cent. On taking the lobsters from the two floating cars fifty-three were missing, and as there were no shells or other traces of them, it is possible that some of them were stolen. The experiment is therefore not entirely conclusive but was sufficiently successful to warrant further attempts at penning lobsters throughout another season.

In the matter of equipment for hatching lobsters there is a diversity of opinion among practical fish culturists. During the past four years the Woods Hole station has operated satisfac-

torily with open-top McDonald jars, fitted with nickel rims and over-flow spouts, the water being conducted directly from these jars into rectangular aquaria of various sizes. No change has been made in the equipment of the Gloucester station and closed top McDonald jars have been used. During the past winter the superintendent has made tests with the open-top Downing jar. This jar is unquestionably preferable to the open-top McDonald jar for the reason that there is no metal about it, which is especially objectionable with salt water. Superintendent Corliss reports that the open-top jar is just as good as the closed-top jar for hatching purposes, but complains that rectangular aquaria with open-top jars do not work satisfactorily. He has been accustomed to hold lobsters in battery jars 15" high and 9" in diameter, so arranged that two hatching jars empty into one battery jar and the combined force of water from these two jars keeps the contents of the battery jars in constant motion. In a large aquarium there is always dead water in some parts, and the eggs and fry collecting there are lost. In holding lobster fry it appears absolutely necessary to keep them in constant motion, in order to prevent bunching and smothering, and also to prevent cannibalism. Mr. Corliss says that another point in favor of the battery jar is its convenience, and the saving of time when putting up shipments of fry and in estimating the number of fry on hand. He states that it takes nearly three times as long to put up a shipment of lobster fry from a large aquarium as it does from battery jars. At the new lobster station at Boothbay Harbor, Maine, Superintendent Hahn has used both the open-top and the closed-top jars, and his experience is very similar to that of Superintendent Corliss. He objects to the open-top jar when used in connection with rectangular aquaria. The tests have not been brought to a conclusion, but apparently there are objectionable features to the square aquaria. These were adopted at the Woods Hole station upon the recommendation of a Special Commission for the Investigation of Lobsters and Soft Shell Clams. It is believed, however, that the Downing open-top jar or an improvement on the same will be decidedly preferable to the closed-top jar for hatching lobsters. It is less expensive than the former, and in addition has the other advantages already mentioned.

It has been customary to transport lobsters to the stations where they are to be stripped of their eggs, and then return them to the waters from which taken. In general this may be considered the best method of transporting eggs, but in order to test the efficacy of stripping the eggs from the lobsters and transporting them, Superintendent Hahn was directed to experiment with a packing case used in the transportation of trout eggs. The trays were first thoroughly soaked in salt water, and nearly 400,000 lobster eggs were then placed upon eight trays. Before placing the trays in the packing case, the bottom was covered with ice surrounded with two inches of salt water-soaked moss. Two empty trays were placed upside down on top of the ice and the trays of eggs were then added. Canvas was wrapped around the trays of eggs, and then the intervening space between the canvas and the sides of the case was filled with alternate layers of moss and crushed ice to the height of the top tray. The eggs were held by this method twenty-four hours and then taken out. They had a thoroughly dried appearance but apparently did not suffer injury. This appears to be the first time that lobster eggs have been transported on trays, and the experiment demonstrates that they can be so transported, precautions being taken to keep them at a proper temperature without permitting ice or fresh water to come in contact with them.

THE EARLY FEEDING OF SALMONOID FRY.

BY CHARLES E. ATKINS, EAST ORLAND, ME.

The initial feeding of salmonoid fry has always been regarded by fish culturists as of critical importance and it has come to be generally considered of urgent necessity that the first manifestation of desire for food should be met promptly by its gratification. Either artificial food must be administered at once or the fry must be liberated in water affording an immediate and constant supply of natural food. Some authorities have even urged feedings in advance of the absorption of the yolk sack. The consequences of even a brief delay in this matter have been supposed to be very serious, extending to the death of all fry subjected to a few days of hunger.

At the Craig Brook station it has been one of the rules most rigidly enforced, to watch the fry approaching the completion of the sack-period very closely, anticipating their appetites by tempting bits thrown in tentatively, and to lose not a day in satisfying the first demand for food. As early however as 1897 a single experiment in fasting had indicated that the question of the soundness of the theories accepted might well be taken up, and with the hope of accumulating data from which safe rules of procedure could be formulated, several experiments in the enforced fasting of fry were undertaken in 1904, and a more extended series in 1905. It is the purpose of this paper to present the most important results obtained from the experiments of 1905.

The data which I will consider concern the treatment of 4 lots of brook trout fry, 4 of lake trout, 8 of Atlantic salmon and 4 of silver salmon, 20 lots in all, that were subjected to enforced abstinence from food; and of 3 control lots which were closely related to the fasting subjects, but were amply fed. All of these fry were hatched at Craig Brook. The feeding and fasting were conducted in troughs a little more than a foot wide, in which a depth of water of about 4 or 5 inches was maintained. The water was mainly derived from Craig pond, a lakelet of great

purity, but was mixed with spring water, the latter constituting perhaps one-third of the supply in part of the trough system and less than one-eighth part in the others. All of the fry were hatched in the supply containing the smaller proportions of spring water, and some of the experiments were begun there, but all were finally moved to the troughs fed by other mixture. The temperature ranged from 50 to 64 degrees F.

The brook trout treated were all derived from eggs received from private parties in Massachusetts, who were rearing trout for the food market, and were of inferior quality and lacking in vigor, as shown by the history of the control lot, No. 1768, out of which were taken the experimental lots, 4 in number, consisting of 1,000 fry each, A, B, C and D. On May 23, the control lot began to feed, and thenceforth received chopped hogs' liver four times daily. Lot 1768 A was not fed until 5 days later; 1768 B was compelled to wait for its first feed 9 days; 1768 C, 14 days; 1768 D, 19 days. As each of them reached the termination of its fast it was fed thenceforth like the control lot, 4 times daily. The results noted were mainly in the list of deaths, which was kept with great care to secure accuracy. The number dying was recorded daily, and for the purpose of this paper the record will be quoted from the beginning of the fast to 15 days after its close. The loss record of 1768 A, thus covered 20 days, and during that time the mortality amounted to 22, or a little more than 2 per cent. The record-period of the 9-day fasters, 1768 B, was 24 days, and the deaths therein were 60, or 6 per cent. The 14-day fasters, lot 1768 C, in 29 days lost 517, or nearly 52 per cent. The 19-day fasters, in 34 days lost 776, or nearly 78 per cent. Thus it would appear that in this series, the losses were severer the longer the fast, and in the case of the longest fast the loss approached annihilation.

Let us now see how these losses compared with those suffered by the control lot, which had been fed constantly from the start, 4 times daily. Comparing the latter with the 5-day fasters (1768 A) the control lot lost four and four-tenths per cent while the fasters were losing two and two-tenths per cent, that is, if these results be attributed wholly to the food, the generous feeding doubled the mortality. Compared with the 9-day fasters

the control lot seems to have reaped a slight advantage from the food eaten, having lost but four and nine-tenths per cent, while the fasters were losing six per cent. When we next compare the eaters with the 14-day fasters, we find the advantage very decidedly in favor of the food; the eaters have lost but five and four-tenths per cent, while the fasters were losing 52 per cent; finally, the victims of the 19-day fast lost 78 per cent, while the eaters were losing 6 per cent.

Whether trout fry of prime condition, from vigorous wild parents, would have suffered as severely as those treated in these experiments is a question we have no means of answering positively; but the presumption favors a negative answer.

The next series of experiments to be considered deals with lake trout fry. Of these there were four lots, of 100 fry each, and their fasts, as in the case of the trout, were, respectively, 5, 9, 14 and 19 days, but in each case the fry had been fed 6 days before the fast began. Accounting in each case for the losses from the beginning of the fast down to 15 days after its close, it appeared that the mortality was a little heavier than with brook trout in the cases of the fry fasting 5 and 9 days, and a little lighter in cases of the longer fasts. There was no control lot of lake trout.

Of Atlantic salmon fry there were two series. The first series embraced 4 lots, of 1,000 each (marked 1847 A, B, C and D), and their fasts were, respectively, for 5, 10, 15 and 20 days. None of them had received any food before the experiments began. The total losses for periods corresponding with the computations for the brook and lake trout, that is, from the beginning of the fast down to 15 days after its close, were respectively, 25, 43, 64 and 217 fry out of each thousand—the percentages being thus two and five-tenths, four and three-tenths, six and four-tenths and twenty-one and seven-tenths.

The second series of Atlantic salmon fasters consisted of four lots of 500 each, from the same control lot as the first series, namely, No. 1847, and the members of this series were distinguished by the letters E, F, G and H. Their losses for similar periods as the other series were, respectively, in percentages, four-tenths, eight-tenths, six and six-tenths and fourteen and six-tenths. As compared with the first series, these were lighter

losses except in case of the 15-day fasts, where it was almost exactly the same. The mean losses of all the lots of the first series were eight and seven-tenths per cent, and of the second series five and six-tenths per cent, a difference of three and one-tenth per cent in favor of the second series. As these fry, both series, were taken out of the same original lot, the difference suggests the query whether there was any difference in the treatment of the two series. There was a difference, which I will now state, without, however, claiming that it explains the difference in results.

It had occurred to the experimenter that fry that were denied artificial food might still be able to pick up a trifle of food in the form of minute animal life brought in with the water-supply, to tide them over the waiting period. In order to eliminate this source of uncertainty, one series of the Atlantic salmon fasters was kept in water filtered through gravel and sand which must have intercepted most, perhaps not all, natural food. Now did the fry so treated show any effect of being deprived of an equal opportunity to snatch a possible bite of live food now and then? On the contrary, the fry so rigorously treated had lighter losses than those in unfiltered water. The general summary for the series in unfiltered water show a loss of eight and seven-tenths per cent, for those in the filtered water five and six-tenths per cent, a difference of three and one-tenth per cent in favor of the filtered water.

Now how do the losses of the fasters compare with those of the control lot from which they were taken and which had been fed 4 times a day? As in the case of the brook trout the five day fasts were accompanied in each series of fasters by a lighter loss than in the fish that were fed. The 10-day fast of the first series was accompanied by a little heavier, and that of the second series by a very much lighter loss than in the control.

The facts already stated are certainly surprising, but the most astonishing part of this experience is still to be laid before you. It pertains to the experiment with silver salmon. [*Oncorhynchus Kisutch*] This Pacific species the station has handled this year for the first time. For the fasting experiment 4 lots of them were counted out, 500 fry in each. They were ready to feed May 18, and on that day the feeding of the control lot began, at

the rate of 4 feeds per day of chopped hogs' liver. The fasts were for 5 days, 10 days, 14 days and 19 days. The losses of the first three lots for the usual period, that is, from the beginning of the fast down to 15 days after its close, were exactly alike, 8 fish dying out of each lot, a percentage, for the entire period, of one and six-tenths. The lot that fasted 19 days lost—in 34 days just 6 fry, a percentage of one and two-tenths. Comparing now the 4 lots with each other and stating the losses in the ratio of the daily losses per 10,000, the fasters for 5 days lost 8; the fasters for 9 days lost six and four-tenths; the fasters for 14 days lost five and one-half; the fasters for 19 days lost three and one-half; eight, six and four-tenths, five and one-half and three and one-half. That is, the longer the fry fasted the lighter the mortality. Comparing now the fasters with the control lot it is found that the latter, the feeders, lost at the rate, stated in daily loss per 10,000, for the different periods, 13; ten and four-tenths; nine; and seven and seven-tenths. A mean of these losses would be 10 daily out of 10,000 or one-tenth of one per cent, while the mean loss of the fasters was five and eight-tenths daily out of 10,000, or one-seventeenth of one per cent. That is, taken all together, the feeders lost almost twice as heavily as the fasters.

To sum up for all the species except lake trout, the 5-day fasts were in all cases accompanied by lighter mortality than that suffered by the feeding fish; the 9 and 10-day fasts by lighter mortality in some cases, by heavier in others; the 14 to 20-day fasts by heavier mortality except in the case of silver salmon.

The subsequent behavior of the fry deserves a moment's mention. The fry appeared, during the extended fast, to grow thinner in body, but when feeding began they were in every case ready, at once took to eating and in a few days showed that they were building up.

What practical lessons are to be drawn? Far be it from me to insist that this series of experiments be taken as concluding the matter. It is only one series, and needs support from others. Yet the results agree in general with those obtained in 1904 and earlier, at the Craig Brook Station, and surely indicate that an early and abundant supply of food is by no means so essential to trout and salmon fry as we have supposed. They even go

further and open the question whether feeding at the initial stage has not been overdone in the past, both as to time and quantity. Possibly it might be better to wait a few days longer or to limit the quantity or frequency. But these are questions that should be very carefully investigated, and I urge the study of the matter upon all fish-culturists.

TABULAR STATEMENT OF FASTING EXPERIMENTS.

LOT MARK	SPECIES	PREVIOUS TREATMENT	FAST		RECORD OF LOSSES		Census at Start	DEATHS		Daily per 10,000
			Begins	Ends	Length Days	Ends		No. of Days	Whole Term Count		Per ct.
1847 A	Atl. Salmon	No food	June 4	June 8	5	June 23	1,000	25	2.5	12
1847 B	Atl. Salmon	No food	June 4	June 13	10	June 28	1,000	43	4.3	17
1847 C	Atl. Salmon	No food	June 4	June 18	15	July 3	1,000	64	6.4	21
1847 D	Atl. Salmon	No food	June 4	June 23	20	July 8	1,000	217	21.7	62
1847 E	Atl. Salmon	No food	June 4	June 8	5	June 23	500	2	0.4	2
1847 F	Atl. Salmon	No food	June 4	June 13	10	June 28	500	4	0.8	3.2
1847 G	Atl. Salmon	No food	June 4	June 18	15	July 3	500	33	6.6	22
1847 H	Atl. Salmon	No food	June 4	June 23	20	July 8	500	73	14.6	42
1847	Control lot	No food	No	Fast		July 8	15,010	646	4.3	12
1768 A	Brook trout	No food	May 23	May 27	5	June 12	1,000	22	2.2	11
1768 B	Brook trout	No food	May 23	May 31	9	June 16	1,000	60	6	25
1768 C	Brook trout	No food	May 23	June 5	14	June 20	1,000	517	51.7	177
1768 D	Brook trout	No food	May 23	June 10	19	June 25	1,000	776	77.6	228
1768	Control lot	No food	No	Fast		June 25	15,438	936	6.1	17.9
1747 A	Lake trout	Fed 6 days	May 23	May 27	5	June 11	100	3	3	15
1747 B	Lake trout	Fed 6 days	May 23	May 31	9	June 15	100	9	9	38
1747 C	Lake trout	Fed 6 days	May 23	June 5	14	June 20	100	42	42	145
1748 D	Lake trout	Fed 6 days	May 23	June 10	19	June 25	100	72	72	212
1832 A1	Silver salmon	No food	May 18	May 22	5	June 6	500	8	1.6	8
1832 A2	Silver salmon	No food	May 18	May 27	10	June 11	500	8	1.6	6.4
2832 A3	Silver salmon	No food	May 18	May 31	14	June 15	500	8	1.6	5.5
1832 A4	Silver salmon	No food	May 18	June 5	19	June 20	500	6	1.2	3.5
1832 A	Control lot	No food	No	Fast		June 20	500	13	2.6	7.7

DISCUSSION.

President: Perhaps there are some gentlemen here who have had experience in the same line, and who would like to make some remarks on the question. We should be glad to hear from them if they have.

Mr. Titcomb: How do you determine the actual number of days that have passed, so as to know when to begin reckoning the period of testing and feeding?

Mr. Atkins: We carefully watched the fish, and whenever the general lot was ready to feed then we reckoned that the fasting began. For instance, the control lots were taken out of the same original lots as the fasters, so they were all originally the same lot of eggs. One section would be set out to be fed and another to fast. Those that were set out to be fed would be tried carefully, and the regular feeding begun the moment they began to take food, and from that time on we began to take our records.

Mr. Clark: These accurate experiments noted down are very important. If conclusive, we need not hurry out our fry, as I have done for many years, for I have always made it a point to distribute fry before the sac was entirely gone. We were afraid that otherwise the fish would begin to starve before they found their natural food. At the present time most of the people distributing fish go on that plan; they try to get them out as fry before the sac is entirely gone, because they are afraid that otherwise the fish will starve. But, Mr. Atkins, even with our feeding as we do now, that is, putting our fish in the feeding trough before the sac is gone, we still find from two per cent to five or ten per cent that starve and drift down to the screen. Now, do you think that they are starving, or are they simply weak fish? Did you make a note in your experiments as to any such weak fish?

Mr. Atkins: While the lost are all recorded, although I did not personally look into the trough to see whether the fish were up at the head of the trough, or down at the foot, and did not ask any questions about it, I presume, as is usually the case, that most of the dead fish were found at the lower end of the

trough, and that they were probably weaklings. Why they were weaklings I think is an open question; but I am more inclined than ever, after these experiments, to think that the weakness must have been originally with the fish, and was not because they were lacking food or had failed to get their share, and that they would have died anyway. In fact, as was seen in general, we found that the fish that were fed liberally, lost more during the short periods, five and ten days, than those that had no food given them at all. So I think that the probability is, that when we are able to investigate that question very closely, we shall find that the cause of the death of those fish is generally something besides lack of food.

Mr. Clark: Do you now think from these experiments, that you will feel warranted in not hurrying to get your fry out? I take it for granted that you have been distributing fry and that the aim has been to get them out before they were too old.

A. Yes.

Q. And now do you think that you will be warranted in taking more time, if necessary, and not hurrying?

A. Well yes. I think we will be warranted in taking more time; but I would not like that series of experiments to be taken as conclusive. We must keep trying, and I hope to be able to try the experiment more extensively another season. I shall now dare to experiment with a larger number of fish than I did before, and possibly I will feel a great deal surer of my ground another season than I do now.

Mr. Dinsmore: I would like to ask if, in the case of the fish in the controlled lots, the base on which the percentage was reckoned was the same as in the experimental lots; that is to say, whether in the controlled lots you had more fish in the troughs than in the experimental lots. I did not catch the point.

A. No, I have a tabulated statement that will answer that question. In the case of the first series of Atlantic salmon there were 1000 in each case, in the first series of the experimenting; and there were 500 in each of the four of the second series of experiments; and the control lot was a larger lot containing 15,000, and was held in quite a number of troughs. I cannot state how much room, comparatively, those fish had, but in the

case of the brook trout, the number of brook trout in the control lot was very large. In the case of the silver salmon the control lot was just the same size as the experimental lots, 500 in each lot, and they had the same room. And the performance of the fish that were fasting was much above those that were fed.

Mr. Talbott: It seems to me that it would be of some interest to know what the final effect on those trout might be. I know more about pigs than the raising of fish, and a pig ill-fed in its early months becomes permanently stunted. Is there no fear that starving the trout will so stunt the fish that it will never reach the size that it would otherwise reach at maturity?

Mr. Atkins: I think there is good ground for suspecting that it will have that effect. The experiments of 1904 were made in June and July, but I intended to carry all the fish experimented with, through to October, and then to weigh the different lots very carefully, and see which had gained the most, and how much the fasters had suffered in their growth during the season; but unfortunately the troughs were little experimental affairs, standing side by side, and were not guarded against each other; and too many fish jumped over from one to another and got mixed up, so that I could not rely on the results. This year, however, those lots are all to be carefully kept separate, and in October I shall weigh them all and then be able to answer that question. But to the eye they seem to be keeping up well, and we hope that even in the case of the longest fast, the fish will be pretty good fish when fall comes. Of course I do not wish to be understood as claiming that there is any likelihood of our finding any advantage in keeping fish fasting 19 or 20 days — I do not expect that. I do not even expect that we shall find that it is any better for them to fast ten days; and perhaps it would not be quite so good on the whole, but I do think that there is a great probability of its proving finally that there is no particular hurry about turning the fish out in the beginning, and if it is desirable for any reason to interrupt feeding 1, 2, 3 or 4 days, we need not fear any untoward results from the interruption. It may be necessary in case of the attack of some disease to put a group of fish on a limited diet, or have them go without food for a number of days; and if such experiments in

the future lead to similar results as these that I have reported, then we should feel quite safe to do such things.

Mr. Clark: I think Mr. Atkins has stated in his discussion that in 1904 the fish became mixed.

A. Yes.

Mr. Clark: That was the first time we heard you say anything about 1904. In the paper you did not give us those figures.

Mr. Atkins: I mentioned the fact that I tried it in 1904.

Q. Did you find the percentages run the same in 1904 as in 1905?

A. Yes, about the same.

Mr. Marsh: Was every remnant of the sac in the 19 day lot absorbed before the period of fasting began?

A. Yes.

Mr. Dean: This last spring we took a lot of 1,000 trout up to the spring to test the water; it was over 2 miles up there, and we could not feed the fish more than once a day; but they did as well or better than those fish that had been left in the hatchery. But in taking out fish for experiments, oftentimes we take them out of a lot of fish, and necessarily dip out the best ones; and you leave the inferior fish in the trough for control; as far as percentage went, those that went to the spring did better than those that were left in the trough. When there are a lot of fish in a trough, the weaker ones go to the lower end, and you usually go to the head of the trough to dip out fish for experiments, and thus get a superior lot.

Mr. Atkins: I thought of that point after the experiments had been concluded, and I asked my foreman, who had direct charge of the matter, whether he tried to select the best fish, or whether he tried to select just a fair average of them, and he told me that he tried to avoid selecting the best fish but to make a fair average. His effort was in that direction; but of course it is quite possible that unintentionally the men who

counted those fish out, did get rather better than the average. In fact it would not surprise me, if that turned out to be exactly the case.

Mr. Dean: That is what I mean: you do not intentionally do so, but cannot help it, because in dipping up, the weak fish will not get into your nets.

Mr. Atkins: I am hardly ready to accept that theory. I think the weak fish will get into the net as readily as the good ones.

Mr. Dean: Yes, if you went clear to the bottom you would get the weak fish, but if you just simply get the fish from the top of the trough, you will get the stronger and hardier specimens.

Mr. Atkins: In our way of handling we go to the bottom every time. We dip up fish with nets with flat fronts. The water is only five inches deep and we dip clear to the bottom of the troughs every time.

Mr. Clark: Would it not be better for Mr. Atkins if he makes a similar experiment another year, to go further back than the fry when they are swimming up, and take a tray, say of 5000 eggs, for your control lot, and a tray of eggs for your different fasting lots. Then you will have the weak and strong all together. Then I think you would come nearer a correct result than by the present method.

Mr. Atkins: Yes, if you are quite sure your eggs are alike on the different trays; and I think it would be well worth while to begin with the eggs, instead of waiting for the fry.

Mr. Clark: Start after your eggs are eyed.

Mr. Titcomb: In your observations or experiments, have you observed that fry do not take any food whatever until the sac is entirely absorbed?

Mr. Atkins: I have not observed. I have not studied them in that direction enough to say.

Mr. Clark: I have seen them take it before the sac was gone.

Mr. Atkins: I think I have seen that thing happen. It will snap at it at any rate.

Mr. Clark: I have seen them take liver.

Mr. Titcomb: It has been quite customary, and believed to be desirable at many stations to begin to feed fry before the sac is absorbed, sometimes giving them nothing but blood. But in this case I wondered just how you knew when the sac was entirely absorbed. I thought you judged the fasting period as against the feeding period by the time the fish began to take food rather than as to whether the sac was entirely absorbed or not.

Mr. Atkins: You are correct. We go rather by the indication of the fish as to whether they want food than by actual examination, to determine the absorption of the sac. Those have been my instructions to my assistants, to try the fish, and whenever they are ready for food to give it to them. But in general it can be said that we began about the time the sac was absorbed. I do not think that in case of our fish there has been any general anticipation of the absorption of the sac in their taking food, although not having studied that point very closely I would not like to be certain of the absolute correctness of the statement.

Mr. Titcomb: Then if the trout, in your experiments, came up to take food a little before the sac was absorbed, this experiment may have been begun a little before the sac was absorbed?

A. It is possible.

Secretary: There are some communications from members asking questions in regard to trout, this being the subject under discussion.

I have received with the following report a letter containing a question which is as follows:

"There is one question, recently called to my attention, in relation to fish culture, which I should be very much pleased to have discussed by the society.

I am President of the Grand Mesa Lake and Park Company, the proprietor of 13 large lakes on the Grand Mesa in Colorado.

which contain a very great many native mountain trout. These lakes are under lease to the United States government for the purpose of permitting the United States Fish Commission to take therefrom spawn for government use in propagation. The present superintendent of the hatchery claims to me that the large male trout in the lakes are very destructive to the fry, a portion of which are each year returned to the lakes by the Fish Commissioner, and advises that a large number of these males as stripped be not returned to the lakes, but marketed.

This is the first time I ever heard that the male native trout are more cannibalistic than the female, or that the native trout was essentially cannibalistic, except where other food was scarce. Other food being abundant in these lakes I have never supposed that the fry were suffering in that way.

Yours truly,

D. C. BEAMAN."

Another gentleman asks, to what age do brook trout attain?

President: I think this society ought to have some members able to answer almost any sensible question in regard to trout, and I hope that we shall hear from some one.

Secretary: I should like to hear Mr. Titcomb's opinion on both these questions.

Mr. Titcomb: I have heard a great many stories about trout living to a great age, enclosed in spring holes, where they have very little food, but had water of a perfect quality and absolute aeration probably; and they did not attain large size. I would not want to say how many years they would live under those conditions. I do not think that we are capable of judging of the age of trout at all by those we keep in our hatcheries under domestication.

Mr. Meehan: We have had brook trout live in our hatcheries about 24 years, the males living longer than the females. We find too, that as a rule in our hatchery ponds, the trout do not attain the same size and weight as those that may be caught in the streams. I have a record at my office this year of something like 30 brook trout (that is the charr), caught in Pennsylvania waters, that will run from three and one half to four pounds,

and one or two a little over four pounds. We have never had any of that weight in our ponds.

We have had California trout for fourteen or fifteen years, and in that case the female seemed to have greater vitality than the male, and lived longer. We had a few specimens of the California trout which we carried through to that age, and in each case the female ceased to spawn at about twelve years. At our Corry hatchery they thrived better than at some other hatcheries.

We have some lake trout in our ponds that were there nearly thirty years ago, and were young fish at that time.

Secretary: It is strange but true that there seems to be no data giving the age of trout.

Mr. Dinsmore: I have been waiting for some one to speak of the cannibalistic nature of the black spotted trout. I will not make positive statements, but I have frequently found black spotted male trout so gorged with eggs, that I have taken them off the beds and attempted to strip them for females.

In connection with these very lakes about which the gentleman has asked a question, I came from them last Monday, and just below the troughs where we were eyeing the eggs over into the lake, and there the big schools of black spotted trout were eager to pick them up. I presume they would have picked them up just the same if they had been live eggs.

Mr. Titcomb: I can answer that question, about the cannibalistic nature of the trout, or the tendency of the male trout to eat the eggs of the females. I observed one small bed under a rock in a lake in Canada, where a person could look down and see the performance of the fish. Twenty-seven trout were taken off this spawning bed, although there were but two females which were in spawning condition, a few spent females, and the balance were males which were there eating the eggs as fast as they came from the female.

Mr. Hubbard: Did you not observe the female eating the eggs as well as the males?

Mr. Hubbard: Yes, the spent females.

Q. And would not some of the females eat their own eggs after spawning? I have seen brook trout do that.

A. Yes, sir, I understand that is an accepted fact.

THE PASSING OF THE NATIVE BROOK TROUT.

BY JOHN D. WHISH, OF ALBANY, NEW YORK.

Mr. President: I should like to introduce my paper by presenting these few verses which seem to me to be interesting and appropriate.

"Where do I get some trout to-day?"
Asked the fisherman, blithe and gay.
The boy looked shy, but he made reply:
"You don't catch any this way.
There aint no trout, not hereabout
Where the big ones used to be,
And I guess, if you look at the old trout brook,
You'll understand why," said he.
"There's a pulp mill up on the river,
And a tannery further down,
And the fellows that look at the old trout brook
Just hustle right back to town."

It is the object of this brief paper to state the fact, express a belief and cause if possible, helpful discussion.

My proposition is that the native brook trout, commonly called "the old fashioned speckled trout," and scientifically known as the *Salvelinus Fontinalis*, is doomed to become extinct, and is even now passing away. My remarks are applied to New York state, but there is ample reason to believe that they will apply also to several other states.

This matter has been brought to my attention by letters passing through my hands as secretary of the New York State Commission, and by remarks of fishermen returning year after year from their favorite waters. It is presented at this time, not as anything particularly new or startling, but for the purpose of making the fact a matter of record, and for the more particular purpose of getting the society to discuss the proposition along particular lines and with special reference to trout diseases.

The destruction of wild things is nothing new, however regrettable it may be. The American Indian has passed away

before the march of civilization; the buffalo which he hunted on the great plains is gone; the wild pigeon of our woods is no longer seen; the coarser shad no longer ascends our rivers; and why should not the brook trout be a like victim of circumstances? We may not like to admit it, but is it not a fact?

In thinking this matter over, I am surprised that the brook trout has not long since disappeared. I honestly believe it would have so vanished had it not been for the millions of artificially raised fish which the Commissions of the several states have carefully planted each year for many years past. Look at the situation as it exists with us in New York alone. The forests which once clothed the Adirondacks and the Catskills have in part disappeared. As a result, the volume of flow in our streams has dwindled away, the water has become warm, and the natural food of the trout must have to a great extent disappeared. More than this, our water courses are in many cases no longer undefiled. They carry the nameless pollution of civilization. In the Adirondacks they have had the outpourings of tanneries, saw mills, and (most deadly of all) of paper mills. In the Catskills, in addition, they are occasionally getting the refuse of cheese factories. In each case they are no longer fit water for trout. Further, there has been a steady increase in number of detrimental fish in our trout waters,—not necessarily undesirable fish, for sometimes in the Adirondack lakes it is the bass; but there is no denying the fact that the carp and the suckers and other spawn eaters have made great advances in numbers in recent years.

Also there is another and very serious danger confronting the brook trout, in my judgment, and to this particularly let me call your attention. I refer to what are called "parasites" and to the diseases due to their increase. A year ago I reported to the Society a remarkably fatal epidemic among our brook trout at the Cold Spring Harbor hatchery, which also effected the large private preserves in other parts of Long Island. We had prompt aid from Commissioner Bowers at the time, and the disease was carefully studied by Mr. Marsh of his expert staff, but beyond his careful study of the disease, we thus far know nothing. Yes, we do know that it has recurred, and that it has again destroyed all the adult fish there and elsewhere in the

vicinity. It therefore seems to me that the time has come for the men interested in fish culture, and particularly in trout culture, to get together and aid each other, if so they may. Because, if we can no longer keep stock fish in our hatcheries, the day of the brook trout is being hastened faster than most people suppose.

Nor is this dreadful disease the only thing of the kind acting toward the extinction of the brook trout. I mean to speak frankly in the hope that others will also. The parasites that kill are increasing yearly in our waters. We cannot keep stock fish (brook trout) in any of our hatcheries. The Adirondaek hatchery supplied by Lake Clear; the Caledonia hatchery with its magnificent water supply from an underground river; Cold Spring which has already been mentioned; the Catskill mountain hatchery known as the "Delaware or Margaretville," not to mention the hatcheries at Pleasant Valley and on the Fulton Chain, are out of business so far as keeping a stock of fish on hand from which to take eggs is concerned. At the Adirondaek and the Caledonia hatcheries in particular, where the water supply is both clean and cold at all times, we have a form of parasite that is known to you all. It seems to effect the brook trout only and is commonly known as the "fish louse." Scientific men who have examined fish seriously effected say we are suffering from an unusual number of a copepod which they call the *Lernaepododa Salmona* Linnaeus. They say also that it is common in the west and east and that when it exists in large numbers it "seriously affects" the trout. This is an easy way to put it. The fact is that it kills the fish.

Now the serious aspect of this case with us is found in the fact that this parasite is steadily increasing and has invaded nearly, if not all, the waters of the western Adirondaeks. Thus far the waters of the eastern side of the Adirondaeks seem to be but slightly affected. We have been very careful for years about distributing our trout, so as not to help spread the pest, but it has increased in spite of everything. It is not any longer confined to the water feeding hatcheries; it has invaded the mountain lakes. The best advice we can get is given by an eminent scientific man in these words: "No method has been found of getting rid of the adult parasite, but in the early stages it can

be destroyed by introducing small fish that feed at or near the surface of the water and freely eat the larvæ of the parasite swimming there." He recommends to us the fresh water killy, sometimes called the grayback.

I believe that something of the kind of pest mentioned has also gotten into the waters of other states. Michigan, Pennsylvania and Wisconsin have been reported as suffering from parasitic diseases, and we would like to join hands with them in making a fight against the invasion of our troutwaters, especially our lakes. Our new Commissioner, Hon. James S. Whipple, is not only a thoroughly practical business man, but he also is an ardent fisherman and is particularly interested in hatchery problems. He has invited scientific men to use our hatcheries for the purpose of study and experiment, and already we have students of the aquatic insects of the Adirondaeks at work in one of the hatcheries. We hope for results and are willing to help secure them.

But enough has been said, I think, to warrant a free and helpful discussion of the problem which I believe confronts brook trout raisers. The cutting away of our forests may be at the root of all the trouble, and in our state we hope to restore the trees to our waste hillsides in time. But to do this will take at least the lifetime of this generation. In the meantime we can plant a species of trout that will thrive in the warmer waters, wherever there is a sufficient volume of flow to warrant it. The pollution we can in a great measure prevent, and it is an encouraging thing to know that in the Adirondaeks one of the largest paper mills has been trying to find a scientific method of getting rid of its waste and seems to have succeeded.

I quote from the report of the legislative committee of New York appointed in 1904 to investigate this question.

"While at Ausable Forks, the Committee visited the large pulp mills of the J. & J. Rogers Company for the purpose of examining their method of preventing the refuse from their mills from polluting the waters of the Ausable River. The subject of the pollution of Adirondaek streams by pulp mills refuse has long been one of public interest, and the Rogers Company claims to have solved the problem to a considerable extent. The company for some time has had in its employ Mr.

J. S. Robeson, a chemist, who has been experimenting at Ausable Forks with a new process of evaporating the waste liquor from the digestors. A small plant was erected so that a practical demonstration might be made, and the result is claimed to be very satisfactory. The water is freed from all foreign substances, including the pulp fibre, which is utilized for sizing paper, etc. It is also, by further treatment, hardened and made into cores for paper rolls. The experimental plant, according to a recent report from the company, has worked continuously since the committee's visit and has taken care of 10 per cent of the waste liquor from the sulphite mill. A larger plant designed to take care of the entire output of the mill is nearly completed and is expected to be in operation before May 1st. If such a plan were to be adopted by other sulphite mill owners the Committee believes it would go a long way toward remedying the evils of pollution against which complaint has been made."

Where the bass has been planted surreptitiously, there seems to be an end to the brook trout, as is the case in the waters of the Fulton Chain and in other lakes; yet we can do something to keep down the spawn eaters and we are doing it. But before the onward march of the parasites we are helpless.

The state of New York has planted an average of more than three million of brook trout every year in its waters for the past seven years, and the U. S. Commission has planted many millions more; but even this great effort at replacing the disappearing fish has not had the effect that one might reasonably expect. It is for this reason, and for those already given you, that I have chosen as the title of my paper, "The Passing of the Brook Trout." It is not a pleasing situation to contemplate, but it seems to me we may well say of it that, "It is a condition and not a theory that confronts us." Would it not be well to pause in our efforts to get big returns from our hatcheries for a time and to give strict and earnest attention to the problem of preservation?

While closing this paper there came to me the recently issued two volume "Guide to the Study of Fishes," by President David Starr Jordan of the Leland Stamford, Jr., University. In his chapter on the Salmonidae he says:

"The trout are rapidly disappearing from our streams. In

the words of an excellent angler, the late Myron W. Reed of Denver, "This is the last generation of trout-fishers. The children will not be able to find any. Not that brook trout will cease to be. They will be hatched by machinery and raised in ponds and fattened on chopped liver, and grow flabby and lose their spots. The trout of the restaurant will not cease to be. He is no more like the trout of the wild river than the fat and songless reed bird is like the bobolink. Gross feeding and easy pond life enervate and deprave him. The trout that the children will know only by legend is the gold-sprinkled, living arrow of the white water; able to zigzag up the cataract; able to loiter in the rapids; whose dainty meat is the glancing butterfly."

DISCUSSION.

During the reading of his paper Mr. Whish said: The pulp mills use lime and sulphuric acid, and I do not know of any two substances, either alone or in combination, which will kill anything that is alive, quicker than those two.

We have taken tons of suckers and fish of that kind out of our lakes every year. We give them to the farmers for fertilizers.

In my judgment, the United States Commission can more profitably employ a lot of high priced scientists in the solution of this problem of parasitic disease of fishes, which means the preservation of an important and desirable supply of food, than in giving their attention to chasing butterflies and naming prize snakes of various kinds.

(Laughter and applause.)

Secretary Peabody: Mr. Whish has thrown a little slur on the modest sucker, as being a spawn eater and destroying trout. I would like to learn from some of these fish culturists what they know about the influence of suckers in ponds and streams where trout have thriven for centuries. I know of one little pond about the size of this room, at the sources of a brook in Wisconsin, and in its deep quiet pools the bottom seems solidly massed with suckers. It has a peculiar quality of water, with a peculiar sort of grass in it, suspended below the surface of the water; and if you cast a fly or minnow in the water, trout from 12 to 15 inches long will dart from under this growth just

as fast as a person can cast his hook, and that pond has been fished in for a number of years, and any one that goes there can easily get a handsome basket filled with trout; and yet those suckers have probably lived there for centuries, and the trout are there too; and it does not seem to have any influence in the supply of trout.

Mr. Meehan: The department of Fisheries of Pennsylvania, in this matter, is between the Devil and the deep sea. The people who own trout streams are constantly writing to the department, asking for permission to catch suckers from their streams, on the ground that they are destroying the spawn of the trout. Within two weeks I have had letters from two prominent associations owning trout streams, making this demand, and in both cases they stated that they had positive evidence that the suckers were spawn eaters to a very great extent; that they had actually seen them at work on the spawning beds. Personally I have not seen them devouring the spawn, but we get this testimony from all parts of the state, where the trout thrive.

On the other hand we have a very worthy class of people in Pennsylvania who are generally and commonly known as Pennsylvania Dutch. They live in a section generally where there are to-day no trout, though there were plenty of trout years ago. These men want the suckers carefully protected, and will resist any effort to destroy them. In the low lands of Pennsylvania, in counties like Chester and Lancaster, where we have open meadows and farm lands, the trout are undoubtedly decreasing in numbers; but in the mountain streams, in counties like Wayne and Pike they are decidedly on the increase. The old fishermen who have fished for 50 or 60 years living in Wayne county, report that the fishing is better there this year than it was 30 years ago. In Center county, in the mountains, famous for its trout, they say that trout fishing is better than it was 15 or 20 years ago. But in Clinton, Forest and several other counties in that section, where the lumbermen have simply destroyed the forests, the trout had practically disappeared, but with the passing of the lumberman and heavy restocking from the hatcheries, trout are decidedly on the increase in this section.

Mr. Whish mentions Pennsylvania as one of the states in which the parasite is found. Now I cannot say that that has

come to my knowledge to any great extent, as affecting trout. We have the parasite which badly affects the calico bass, rock bass, and sun fish, in many places; but thus far the trout seems to have escaped, except in isolated cases; and I do not want Mr. Whish's parasite to come over to Pennsylvania.

Our hatcheries too, have been thus far remarkably free from any disease, excepting in the old Allentown hatchery, which was abandoned, and there I think we could trace it to carelessness in not changing blood for 17 years, and the young fish lacked blood corpuscles, and were weak and died off by thousands. We had two or three very bad epidemics, at this hatchery now abandoned, both of which were investigated by the United States government, but I hardly think that we are likely to lose our trout, provided due care is exercised to prevent water pollution. Until this year, Pennsylvania was undoubtedly at the foot of all the states that did anything in the way of preventing water pollution. Whenever there was any effort made to procure legislation, to put a stop to the pollution of our streams, a howl arose from all parts of Pennsylvania, from the owners of industrial establishments, who exclaimed, "What, are you going to destroy our industries for the sake of a few fish?" But the legislature of Pennsylvania has begun to take a different view of the matter, and this last winter there was a decided change, and the prospects of continued water pollution are not very good. Heavy fines and imprisonments we find to be very potent arguments with the owners of industrial establishments. I think the day is not far distant when the tannery man and the chemical man and the creamery man will find it possible to discover some means by which their business can be conducted without pollution of streams. In fact there is a plant now being erected in one of the northern counties where the waste water from the tan bark is taken up and distilled, and the water then run back into the stream, so that there is hope that in a few years we shall be rid even of the tannery nuisance.

Mr. Marsh: I would like to ask Mr. Whish to what extent he has actually noticed the death of strictly wild trout in the Adirondack streams?

Mr. Whish: I have been watching the situation for four years, and what is reported to me is this: That fewer trout are

being caught and that the larger fish are seriously infected with a parasite, mostly the gill parasite. In other words, we are getting fewer brook trout from our Adirondaek lakes than ever before, and many of those caught are infected.

But the most serious thing in this whole situation to us in New York state is the fact that we can no longer carry any brood fish at our hatcheries. We cannot carry safely a single brook trout over 15 months old in a New York fish hatchery. Now you know what that means. We used to get millions of eggs every year from Cold Spring Harbor hatchery, whereas now we get none. The same condition exists at Caledonia where we have the outpouring of an underground river, the year round, with a temperature less than 50 degrees; and yet you cannot keep a single stock brood trout in that water. The Adirondaek lakes on the west side are beyond any idea, infected with this parasitic life. That is the situation confronting us; and when I said I had serious reasons for believing that other states are liable to be in the same predicament, I meant what I said. I have told the honest truth about our state in the hope that other states will lend a hand and help stop this thing. It is all very well to say you do not have parasites, or you do not have the same thing, or it does not exist to the same extent. I will not attempt to refute such statements; but I know that parasites do exist in other states beside ours, and the time is going to come when somebody else will have to stand up before the society, confess, and ask for help, just as I am doing now.

Dr. Gorham: I suppose you find them more or less everywhere?

Mr. Whish: Not to that extent. They are increasing, and nothing is known to science to stop the disease. That problem is not being studied. The scientists are engaged in furnishing a better nomenclature for fishes instead of a cure for the parasitic diseases.

Mr. Titcomb: Do you refer to Lake Clear alone as being infected, or the general chain of lakes?

Mr. Whish: I mean the entire chain.

Q. How long have these parasites existed there?

A. It is my belief that they have existed from the beginning of time.

Q. Do you think the changed conditions due to deforestation or pollution of the waters have caused the increase?

A. I don't know. I have a strong suspicion that way.

Q. It is true, is it not, that there is deforestation around those lakes?

A. Yes, most of the wood has been removed and there is pollution present, and it is growing every year, so are the parasites; and the brook trout are disappearing.

Mr. Titecomb: I think the proposition is beyond the scientist. The same problem presents itself in crowded cities, where, among the poorer classes you have dirty, filthy tenement houses, breeding all sorts of disease, and these diseases go out to a certain extent among the well-to-do classes. But the trout is quite as clean as a human being, and needs quite as clean water; and therefore when you get the filth you have in those lakes you may expect the trout to become diseased. I do not believe the scientist can overcome that difficulty. You must stop water pollution by legislation, and then disease will cease.

Mr. Whish: It occurs to me that your simile about the tenement houses is very good. I had the pleasure of working in New York some years as a newspaper man, and was there when the tenement house agitation was going on, and I know of my own knowledge that the association of tenement house reformers improved that condition. Why can not our scientific men give us a hand and help us in this situation now? I do not imagine that we can control fish diseases in natural waters, but that is not the proposition. What we have is a fish hatchery containing water, the flow of which we can regulate, and we can regulate also the number of fish and their food. Now why can you not successfully combat a disease which is killing that particular kind of fish? I think it can be done, if the disease is studied. I have tried to collect the literature of fish diseases but I do not know of a single general treatise on the diseases of fishes that is published in this country. The only one I know is by Dr. Bruno Hofer of Munich, and that deals with different fish than ours.

Mr. Titcomb: I do not wish to intimate that all these fish diseases are beyond the possibilities of the scientist, but an ounce of prevention is worth a pound of cure; and in the Adirondack Lakes the prevention means to stop the deforestation and stop pollution. In the face of the evils resulting from deforestation and the pollution of waters, science is helpless. On the other hand, in connection with the hatcheries and all over this country, in connection with practical problems of fish culture, the scientist is needed. There is enough to do to keep all of the scientists of the country, including those who are traversing the country on less important missions, on practical problems of this character for years.

Mr. Atkins has given an admirable paper on one of the problems, to-day. This question of suckers should be taken up. Who knows whether the sucker is really a detriment to the fish pond? Who is positive of it and can prove it? We may say that it is a case of the survival of the fittest. If the pond is better for trout than for suckers, the trout will survive. On the other hand, if, owing to deforestation or pollution, it is more suitable for the sucker, he survives the trout.

Mr. Whish: I do not want this thing to stop here. There are men right in this room who know about this matter. I have had letters from some of them. The reason I presented that paper was not because I know more about the subject than others, but because I knew something about it in our own state. We are in trouble there and we are here to confess it; and we want some other gentlemen, who have had trouble of the same or similar kind, to tell us about it. If we are going to have an experience meeting, let us give our experiences, and if we cannot do that, let us pray. (Applause.)

Mr. N. R. Buller: I would like to ask, what have you been accustomed to feeding your trout at your hatcheries?

A. Nothing but liver.

Mr. Buller: I think that is one of the causes of the parasitic growth.

Mr. Whish: So do I, but you cannot get our hatchery foremen to think so.

Mr. Buller: I have followed the cultivation of trout for 28 years, and I find a parasitic growth frequently attached to the trout that are feeding upon liver: while in ponds where the water was coming out of the same stream and where I had both suckers and trout in the pond, and feeding on fish food, they never developed a parasitic growth of any kind.

Now, while the sucker may be a spawn eater, I think he is also a good scavenger; but I have found that the parasitic growth very often occurs in liver feeding, especially when the liver is partly decayed.

Mr. Seymour Bower: Some 15 years ago we used to take about 2,500,000 brook trout eggs at our Paris hatchery, but they began to be attacked by parasites, ulcers, etc., and the trout continued to die off. Our stock decreased until the production ran down to about 800,000 per year. We changed foremen about six years ago, and now we are getting over one and one-half millions per year. Perhaps there may be something in that. Try that.

Mr. Fullerton: We have had some trouble, but it was of short duration. It was our own fault. Our ponds were constructed of wood. That is where we kept our stock fish always. The ponds were allowed to stand there year after year, and when I took up the work 10 or 11 years ago, I found that a lot of the fish were diseased, especially in the gills, and were dying. I said to the man in charge: "I do not believe that these ponds are suitable." "Oh yes," he said, "they are all right." But we commenced to experiment with them, made cement sides, instead of wood, kept the natural bottom, and noticed the difference right off. We eliminated the old stock that were diseased, and put in new blood entirely in these ponds, and found that the loss decreased nearly 50 per cent in a short time. And we found the food had something to do with it. Our man would go out in the morning, take a pail of liver, throw it into the pond, it would settle to the bottom, become sour, and infect the fish. We changed the food and the fish thrived. At the present time in both of our hatcheries there is very little loss from parasites. Nine or ten years ago we lost nearly every stock fish in the pond from parasitic disease, whereas now our loss is less than two

per cent. In case of disease we separate the fish right away, and throw salt in the pond.

Food and the condition of the pond are the important factors. Get as close to nature as possible. That is my belief and experience.

Mr. Whish: I notice one of the speakers said his fish developed ulcers. Apparently the disease which cleaned out the great Cold Spring hatchery has been abroad. I have read the reports of the society and of the United States Fish Commission carefully, and do not remember seeing anything about it. Now this boil disease is a fearful, deadly thing. Dr. Marsh will tell you that he went to our Cold Spring Harbor hatchery and gave his best skill to it. He told us to do some things, which we did. In fact we did more than he told us. We cleaned out every one of those old stone ponds and wooden ponds and put in nice clean cement ponds, and brought down from the Adirondaek region several thousand fingerlings, wild brook trout, and put them in there a year ago. He says that the water is all right, and you would think so yourselves, if you saw it. It is as nice looking water as you ever saw, — ever so much better looking than what you have out here at White Sulphur Springs. It is clean, cold water, so far as outward appearances goes. Everything went along nicely down there up to the first of May. Then the brook trout were 15 months old or more, and they began to die just as fast as the others died a year ago; just as others died 9 years ago; just exactly as they are dying to-day. They have what is apparently a series of boils develop on them. These boils burst just as they would on a human being if let alone, and they contain the same bloody serum found in boils in human beings. The fish died at the rate of 700 a day in the Long Island hatchery; and to-day that hatchery has nothing in it except a few fingerlings raised from eggs, brought from Massachusetts. That deprived New York of a supply of 4,000,000 to 5,000,000 of brook trout eggs yearly, and I do not know where we can make it good.

These are the plain facts about the situation in New York state, and other states will experience the plague later, if they have not already done so.

It is not a pleasant subject to dwell on, but I fear most of us must face the situation sooner or later.

Mr. North: When in Campbellsport I visited the Pleasant Valley hatchery. Everything seemed to be in good shape there, but they cannot keep a brood trout in the hatchery.

Dr. Evermann: The gill parasite was discovered a great many years ago. Long before fish culture began in this country, long before trout of any species were kept or cultivated in artificial ponds, and that species or other species are found in various portions of the United States. I have seen them on the Pacific coast salmon, upon the blue back salmon, upon the cut-throat of the Salmon river, upon rainbow trout in southern Oregon, and on other wild trout. But I am not ready to say that these gill parasites were affecting those fishes very seriously. There was nothing to indicate that they were.

But that is a somewhat different question from what would be the effect of these same parasites upon brood fish at hatcheries and in the Adirondacks. Mr. Whish, I think, makes an excellent point when he speaks of the changed conditions existing in the Adirondacks, due to deforestation, the establishment of pulp mills and other manufacturing establishments upon those streams, changing very materially the character of the water in them.

I have visited a number of lakes and streams in the Adirondacks, including the Racket River, and lakes connected with it; and although I was not fortunate enough to see those waters before they were so changed, I could readily believe that the change has been very great from the conditions that existed when the forests there were virgin, when the banks of streams were lined with vegetation down to the water's edge, when there would be dropping into the stream various sorts of insects, and insect larvæ from the overhanging trees and bushes. The waters of those streams were doubtless colder than now, and flowed much more uniformly then than now, aside from the more serious question of pollution which come from mills of various sorts. Take the Racket River as an illustration. During the spring of the year when there is a flow much above the average in that stream, the taste of the tannic acid in the water

is perceptible; an examination of the water in various places in that stream fails to show the presence of any of the minuter forms of animal and plant life, such as the small crustaceans, protozoans and algae upon which the young trout would have to feed at that time of the year. The leachings of the logs and the presence of bark and fragments from those logs and saw-dust in the stream covering up certain portions of the bed, are alone sufficient, so far as I could detect, to kill out all the food upon which the young fish would first feed.

While it would affect fatally the young fish of that stream and similar streams, I cannot but believe that it would affect the adult fish also, and that brings us to this point then, that a parasite, like the gill parasite, which under normal conditions, in the streams of the west which are usually not so seriously polluted, would not be a serious thing; yet for the fish in those streams where the conditions are not as favorable as formerly, and the fish cannot resist the attacks of that parasite, the disease spreads with startling fatality.

All of which goes to show that in considering these questions many factors have to be taken into consideration. It is not a simple proposition, it is not a simple easy problem. There are hundreds of factors which must be considered. We cannot say the suckers are killing the trout, or the carp of Lake Erie are killing out the white fish. (which is not true, as investigation shows), but many different factors will have to be considered.

Now as to the suckers, I would not be surprised if they might do some harm to the spawning beds of the trout. But ordinarily is not this true: that in the streams in the east where the brook trout spawns, the suckers will not be in those portions of the streams where the trout spawn at the spawning time, or until the lapse of some weeks or months after the trout have spawned? Will not the suckers be found in those portions of the streams, if at all, later in the spring and early fall, long after the trout have spawned, and most likely after the eggs have all hatched?

Take the instance cited by Mr. Peabody, where suckers were found in large numbers, in a certain stream, and trout found abundantly under the banks of that same stream; he did not state the time of year, but I imagine it must have been in the

summer or early autumn, when you would expect to find suckers running far up the streams.

Mr. Titcomb: The doctor is mistaken about the suckers. You do find them on the spawning beds. Suckers seem intuitively to find spawning beds and follow them up in lakes.

Dr. Evermann: That is true of lakes, but I was speaking of streams.

Mr. Titcomb: When I spoke about the sucker and asked whether it was a disadvantage or not, I was well aware that some say the sucker is a destroyer of spawn; but it is a benefit perhaps in another way. Many birds called birds of prey are really useful in this country, and possibly the sucker has its use and furnishes a lot of little fish for food for the larger trout, and perhaps as scavengers has another use. Perhaps we should hesitate to condemn the sucker in trout ponds before the question is thoroughly investigated.

Mr. Clark: One thought I would like to offer in connection with Mr. Whish's paper on the diseases of the parent fish. Have you not in your pond fish which are being kept for the collection of eggs?

Mr. Whish: We have not any longer, Mr. Clark.

Mr. Clark: I think there are a few.

Mr. Whish: There is not a single stock brood trout in the hatcheries of the state of New York.

Mr. Clark: I mean throughout the country. We have all got to get back to nature. Your cement ponds and paraphernalia in my judgment you do not want at all. Get back to nature as nearly as possible and keep your fish in such quantities as to do the work. We have one "wild" pond at the Northville station, where the brook trout are doing well, and by the side of them, in cement ponds fry died rapidly. Now if those fry could have been put in the natural pond, I have an idea they would have lived. The fish we have there that are two years old were put in as fry, and are as handsome two year olds as I ever saw. It is as near a natural pond as can be made under the conditions.

Now where there have been new stations established, start in on the plan of following nature as near as possible, otherwise the brook trout will pass away.

Mr. Atkins: I want to second Mr. Clark's suggestion, and add emphasis to it, that what we need above all things is to follow nature more closely, and try to get away from artificial methods as far as possible.

Mr. Joslyn: It has been a sort of hobby with me for the last two or three years, that if we wanted to raise trout successfully, (and for that matter, most all kinds of fish, but particularly trout) we must follow nature. Building a pond as large as this room with no live water flowing through it so far as I have observed, is not in accord with nature. When I was a boy living in the state of Vermont, I noticed that all the streams that I went fishing in had fresh water with here and there a pond, and an eddy, or a hole under the bank in which the big trout would lie. But except when they were quiet those trout were in the swift water, hunting for their food. It is my belief that if you are going to get rid of disease, you have got to give your brook trout fresh, running water to live in and swim in; and look after their food carefully. The remarks which Dr. Evermann made in regard to feeding, I believe are absolutely correct. I have seen ponds in which it would seem a mystery that fish could live, without the bottom being cleaned. I believe what we are after can be secured by a return to cleanliness, by a return to nature's methods.

Just think of the city of Havana. Year after year it was decimated with yellow fever. Now they have cleaned up the town, they have put sewers in, their refuse is carried out of the city, and there is no more yellow fever to speak of. Why should we not have these diseases in our ponds of stagnant water? Although you may run fresh water in, it is not the live water that you see in your mountain streams. Why should we not have disease from the filth lying on the bottom of ponds? These parasitic diseases are essentially filth diseases, and their prevention lies in a return to cleanliness and nature.

Mr. Marsh: There are one or two possible remedies for these big epidemics, which might work if the fish culturist was willing

or able to put the money in to try them. The fish disease that has prevailed among United States stations, and particularly at Northville, for some years, is a bacterial disease that is caused by a vegetable microorganism, and much can be learned from the study of these bacteria. But that is not the case with the parasite at Cold Spring Harbor, for it cannot be grown artificially; but the parasite, without much doubt, arises in the water, and if you put in a filtration plant of sufficient size, and let all the water go through it, you could take it out. But that would not pay on a commercial basis, and perhaps it would not be advisable for a state or the United States to put it in.

Another remedy that Mr. Clark has in use, which is a partial remedy, that is, it permits a number of trout to be raised, but not so many as the same area would accommodate if the trout were not diseased, consists in putting the fish in a large pond, instead of small, narrow, restricted ponds such as are ordinarily used. But it does its work and prevents disease in this way: it merely increases the space that each trout can occupy, so that when the disease starts it does not transfer from one to the other as readily as when the ponds are crowded.

Mr. Clark: How about vegetation?

Dr. Marsh: The vegetation gives opportunity for natural food, and indirectly in that way is beneficial. Otherwise I do not suppose vegetation enters into the matter very much.

I have just been to the Bayfield hatchery of the Wisconsin State Commission, and been experimenting with an entirely new remedy in this connection: that is, copper sulphate, which has recently been used very largely in municipal reservoirs, both to destroy the algae, and still more recently for killing typhoid. Its use for the latter purpose is very much more restricted than for the algae. The typhoid germ in general is very much like the trout organism, and if this copper sulphate will kill the typhoid germ, one is led to suspect that it would kill the trout organism; and it will do so, but it is very much more fatal to fish than it is to people. You can add a good deal of copper sulphate to water for people to drink, and do no harm; but the trout are exceedingly susceptible to it, and the susceptibility varies greatly in different stations and in different waters. The disease is now

prevailing there and I have been adding copper sulphate to the water in a proportion of one to one and one-half million. On another trial I used one part to one million, and I find that that can be done without harming the trout, while it is fatal to this organism when you make experiments in tubes within a few hours, so that there is at least a fair chance of keeping the water constantly sterilized of this organism and of many others. It reduces immensely the total bacterial contents of the water, and the chances are that it will kill this trout organism. Since the use of the copper sulphate the death rate has been reduced, but that may be a coincidence, as the death rate usually falls at this time of the year. We hope another year, with the permission of the Wisconsin Commission, to commence the treatment, say a month before the disease is expected, which is about the first of June; and we will start in with the copper sulphate about the first of May, with a constant flow, and continue that all through the summer months, until the water cools off. It is the cooling off of the water at that station which checks the disease, because the microorganism cannot grow in cold water. We have a remedy here which can be applied on a larger scale, and with an even chance, it seems to me, of success. It will probably either be entirely successful or fail entirely.

Now, whether we can go further and apply that to the disease that Mr. Whish has at his station, is another matter. There is only one way to get very much evidence on it, and that is to try it in the water itself.

As the trout at Mr. Whish's station are extremely susceptible to copper sulphate, very much more so than at Bayfield, and as, if you use one part of copper sulphate to six and one-half million parts of the water, will kill the domesticated fry at Cold Spring Harbor hatchery, you must use one to seven million to be safe; that reduced greatly the amount of copper, and very likely the solution would be too weak to do any harm to the organism. Perhaps at some future time we may find another cheap poison which can be used on a large scale, but at the present time copper sulphate is the only one that offers any chance of killing the organism without killing the fish.

Mr. North: When I went to the Hammondspport hatchery it was as far from nature as possible. The brood ponds there

had wooden troughs, sides and bottom; there was no gravel there for the fishes to work off any parasites on, and there was a slime in the bottom and on the sides from the liver food. Now it would occur to me that anything like that would be very detrimental to the health of the fish.

Mr. L. N. Buller: It seems to me that we are drifting away from the point of what to feed trout. I think we are giving too much liver, for one thing, and if we get a more natural food we will overcome a great deal of this parasitic disease.

Mr. Worth: It has been my opinion for a good many years, that it is the ponds with still waters that have acted against the trout. I believe that when good trout are confined in ponds, that we are creating conditions which will cause parasites to develop on them. There are members present who were at the Woods Hole meeting two years ago, who visited the private establishments of some of the Massachusetts trout growers; and those people cultivated their trout in ditches. There were two things that impressed me strikingly; one was the immense amount of filth that was in the water from waste food, and the other was the immense number of live trout that were in there. Those present here who were there at that time know that my statement is true. They fed on chopped Menhaden shoveled in almost by the wheelbarrow load, and there were bushels of that refuse on the bottom; and in places along the banks the refuse had formed a veritable skin on the bushes where bailed out, but their fishes were healthy and the owners were making money. However they had flowing water, and I believe it is the still water ponds that create the foundation for lice and other parasites.

Mr. Clark: These fish that I spoke about in Northville are not in rapid water; although there are places where the water tumbles over quite rapidly, to which the fish can go.

Mr. Seymour Bower: I would be very glad to help out Mr. Whish if I could. The trouble with the whole matter is that what works in one case and under one set of conditions does not apply elsewhere under apparently the same conditions. For

a number of years we had a serious epidemic at the Paris hatchery; but we are not losing many trout there at the present time from disease. We do lose from 10 to 20 per cent every year as the result of handling during the spawning season. Our old foreman had grown slack, the ponds were filthy, we could not get him to take as good care of the fish and ponds as we thought they ought to have, and we made a change. Our present foreman is and always has been very cleanly, but aside from that I do not know that anything special has been done. We feed liver the same as we always did, but we do not lose fish by epidemic. We raise them to be 5 to 6 to 7 years old, and there they are to-day. We have very little loss from disease; our loss results from handling during the spawning season; but we raise quite a number each year to offset this loss. In that way we hold the stock to about the capacity of our water supply, which is more or less limited.

I was pleased to have Mr. Worth call attention to the trout hatcheries in Massachusetts, for it is a good deal of a mystery to me how they can handle the number of trout they do in the limited amount of water they have. Take the American Fish Culture Company, for example. I was told by our president that last summer they sold 46,000 pounds of trout, and besides that they are selling a number of millions of eggs every year.

We do not think much of cement ponds, still you go down to Massachusetts and find one concern using cement ponds, and another 4,000,000 or 5,000,000 eggs a year with not over 500 gallons of water a minute. As Mr. Dooley says, "There you a-a-re."

It seems to me if I were in Mr. Whish's place, I would go down to Massachusetts and look the situation over, and if possible hire some of the men who have worked so successfully for many years, and at least allow them to try their methods with your conditions. If not successful then the conditions are at fault.

Dr. Greene: Being a medical man I am familiar with diseases, and it appears to me that these trout are sick; and that that has been the condition right along; and this sickness is a filth disease, and the result of getting away from nature's good

old plans; and with that we have the attendant conditions that come from filth and uncleanness.

Now I have had an experience, as a bass fisher, which may be interesting in connection with this subject. There is a slaughter house near our city, Dayton, the drain of which empties into one of our little streams. The water is cold and apparently pure, and teeming with minnows. Now we can go out into our clean running streams and catch our minnows free from disease, put them in a tank with running water and preserve them. I had in my dooryard a tank 12 x 4 x 6, into which I could put several thousand minnows, and if healthy when put in they always did well. But when we went up to the pool where the blood from the slaughter house drains, it was very easy to catch minnows, and on one occasion we caught two bushels apparently healthy minnows. But as soon as you would get them, if you would handle them the least bit they would develop a fungus disease. I have looked in vain through all our city libraries and everything accessible to me to find any treatise on diseases of fish, and never found anything at all.

Mr. Whish: There isn't anything.

Dr. Greene: These minnows were fat and sleek, looked nice, everything looked favorable, but they had fed on the slaughter house, and they were diseased and infected, and developed this fungus disease.

Whenever you touched one of them and took off the protective slime, fungus would appear, the fish would swell up, a blood blister would appear which would burst, an open sore would develop and the minnow would die.

There is no doubt but that the disease Mr. Whish complains of, is the result of infection.

Mr. Talbot: Mr. President, permit me to make a suggestion which if not practical is at least logical.

There is in Paris a class of men who spend the greater part of their lives in the sewers and these men it is claimed are not only long lived but healthy beyond the average, yet it would seem wasted effort in training a child for such a career to insist on a degree of cleanliness that must needs be neglected in its after life. So the strenuous efforts of our fish culturists to raise the

trout clean may be a necessity since trout can not live in sewers. Until we begin getting closer to nature by the clearing out of our polluted streams it may be useless to expect to raise trout.

Under the circumstances it seems to me the highest ambition of the modern fish culturist should be the evolution of a trout that would be able to live in the tail end of a tannery.

Mr. Miller: Most of the ponds which I have seen are built very much like a window, square at the end, and occupy relatively the position of the lambrequin in this room. Your gate is in the middle of a square end, and there is a dead end across each corner. I think this hatchery of White Sulphur Springs has been built much in the shape of a coffin, and I think if we would build the ponds so the gate would occupy the whole end, and let the water come in so that the water would flow out freely, a great deal of refuse would be moved which does not now get washed out from the pond with the gate in the middle, but collects in the corners.

President: I should like to refer to the plant of the American Fish Culture Company, at Carolina, Rhode Island, and explain how they manage to raise such a large quantity of trout. Their ponds are all lined up with boards, with gravel bottoms, all narrow, their widest pond not exceeding 12 feet. The ponds where they have the best success are only 7 feet wide, with a fall of three inches in 30 feet, and in a pond of that character they will rear a thousand marketable trout, three to the pound, in a year.

In other ponds with the ends like those of the United States hatchery, with boards across the corners, the water flows very rapidly, and there is a long series of those ponds, and they are reinforced almost the whole length by driven wells. They are very successful there with their driven wells. They have several 4 inch driven pipes there that will flow six inches over the top of the pipe. It is remarkable on that account. They keep their breeding trout in these long narrow ponds, and have no trouble at all. There never has been any fungus there, no disease at all. Their trout are all fed regularly on hog's plucks, ground up, hearts and everything all together.

They had a man there who had an idea that these ponds were

not wide enough, and he experimented with one and took out the sides, extended the flow of the water so that it covered a width of probably 60 feet, and put 10,000 marketable trout in there. In less than two weeks every one of them were dead. Now that bears out the theory of the importance of a rapid flow of water.

That is all I think there is to it down there, with the exception that everything is in a wild state. The head of the spring itself, which is very like the one at White Sulphur, is a single spring. They did come very near spoiling it. They thought they would build a big pond, so they raised the dam and overflowed the spring three feet. But they did not keep it up very long; they knocked down the bulkhead and let the water run naturally. They have a flow of nearly a mile where they raise this immense quantity of trout. All their ponds are full, and they have hundreds of thousands of fry, which grow very rapidly. Mr. Titecomb, Mr. Clark, and Mr. Ravenel have seen those, and they saw no fungus, and no disease of any kind on the fish.

They market a great many millions of eggs every year. There is no question about it. Now I do not know why they should be more successful than others in the west; but I can say this about the state of Rhode Island, and about the state of nature. We are decidedly returning to a state of nature. Our sawmills are all gone, the country is growing up back in the rural districts, to brush; the streams are covered with brush so that it is almost impossible to get a line into them in places, but they are full of trout. I have seen 60 to 70 fishermen start out in the morning and at night every one of them return home with a basket of trout. They are getting big trout all the while. There is no trouble about it at all. Our streams there in some places run deep, and in some places shallow, and have considerable flow of water in them; and there the trout grow much larger and better than elsewhere. That I think can be traced right back to the return to nature; because the banks of our streams are covered with brush, and the woods are still there. We cut off the woods 30 or 40 years ago, but they have grown up again. We have no trouble with mills and pollution. If they want to cut down a pine forest they do not put a portable saw mill on the banks of the stream, or they would be arrested. They must put it back away from the water.

The reasons I have given account for the success had in fish culture in Rhode Island.

Mr. Whish: Let there be no mistakes about the conditions connected with the situation I have frankly described in New York state, with reference to our hatcheries. We cannot raise brood brook trout. There is no lack of water supply in the several hatcheries, with the exception of one. The other ponds have some of them wooden walls with gravel and sand bottom, and others stone walls with gravel and sand bottom and some are wholly of cement.

When I refer to the loss of the brook trout, I mean of course the old fashioned speckled trout, the fontinalis, the trout that belongs in your swift, living water, and I mean no other fish. The situation is known to at least one scientific man of the United States Commission, and we will very gladly point it out to anybody else who desires to look into it.

The condition is not a theoretical one, at all; it is a mighty serious one, and I sincerely hope it will never confront any other state, though I fear it will.



The first fish hatchery in South America. Situated at Nahuel Huapi, territory of Neuguén, Argentina. For salmon, trout, and whitefish. Built in December, 1903, by J. W. Titcomb.



REMINISCENCES OF THE FISHERIES IN SOUTH AMERICA.

BY J. W. TITCOMB.

Mr. Titcomb gave an evening's entertainment in an informal talk illustrated by lantern slides, depicting fishing scenes on his voyage from New York to Buenos Ayres and in Argentina. In addition to scenes illustrative of the fisheries, his travels and explorations throughout the country, including a trip to Paraguay, were interestingly illustrated and explained.

From September 1, 1903, until June 1, 1904, Mr. Titcomb was in the employ of the Argentine Government to explore the waters of Argentina and make recommendations with reference to the introduction of desirable species of food fish. His explorations covered a large part of the country from the province of Cordoba on the north to the northern border of Patagonia in the territory of Neuquen, in the southern part of the country. He ascended the La Plata and Paraguay Rivers to Asuncion, Paraguay.

While in the country he built what is probably the first fish hatchery in South America on a tributary of the Linay river, near Lake Nahuel Huapi. It is constructed out of hand-made lumber. Before his departure from the country eggs of four species of Salmonidae had been transported from the United States and placed in the hatchery with a loss of less than ten per cent. The loss in hatching and previous to distribution was very slight. The success in transportation merits special mention because it is probable that these eggs were carried a longer distance than has heretofore been recorded in the history of fish culture. Another feature to be considered is the fact that the eggs were taken from a climate where the waters were extremely cold, across the equator, and then during warm weather, one hundred leagues across the hot sands of the territory of Neuquen to be hatched at just the opposite season of the year from that in which they would have been hatched under natural conditions.

The work inaugurated by Mr. Titcomb is being successfully continued under the direction of E. A. Tulian, a member of the American Fisheries Society, formerly superintendent of the fisheries station at Leadville, Colorado.

DISPLAY OF APPARATUS.

It was expected that all the superintendents of the U. S. Bureau of Fisheries would attend the meeting, and all had been invited to bring fish cultural devices of novel design, that is, some of their own devices which may be new to others. As a result of this invitation the following apparatuses were on exhibition at the White Sulphur Springs Station, and one morning session was devoted to a discussion of the merits of the various kinds of apparatus and methods employed in fish cultural work in connection therewith.

Mr. Frank N. Clark gave an exposition of the Clark and Clark-Williamson hatching troughs. This was followed by Mr. Atkins, who gave an exposition of a hatching box used at the Craig Brook station under the Atkins method of eyeing eggs in stacks of trays enclosed in a stack frame. The merits and demerits of other forms of apparatus and equipment were discussed fully, but as the discussions were always illustrated by the presence of the apparatus or equipment, or models of it, the minutes of the discussions are not included in this report.

Mr. Clark exhibited the Clark hatching box, nine trays to the compartment, the Clark-Williamson hatching troughs, 15 trays to the compartment.

Two quart dipper for measuring eggs.

Whitefish scaff net.

Another scaff net for trout.

Same only smaller.

Hatching jar tube.

One quart measure with screened bottom for measuring trout eggs.

Feather with long handle.

Jar screen.

Tray for holding dead eggs.

Larger tray.

Bass fry net for taking fry out of screens.

Whitefish fry net for taking whitefish out of tanks.

Three pronged hook for removing lumps from jars.

Jar filling tube.

Long mesh screen for sorting fish from eggs.

Long drip pan for washing up fish and eggs.

Exhibited by Mr. Atkins:

Ten tray stack frame with complement of trays. This size preferred when there is room enough in the hatchery. To pick the eggs they are removed to a table, the whole stack being removed.

Troughs used for both eggs and fry. The water level mounting by dam: for fry by a hollow outlet plug and screen being put in place of the dam.

Stack hooks for lifting the open stacks out of the trough.

Deep stack frame for twenty trays of eggs, holding 40,000 salmon eggs. This is a closed frame and may be used with eggs or in an open stream. Requires trough 16 or 17 inches deep: is taken out for picking.

Egg pyers used at Craig Brook.

Dinsmore's tray lifter, used for lifting trays on which the fish are hatching (pair).

Pair Storey's tray lifter, founded on Dinsmore's.

Dinsmore fry picker, to pick up dead fry and other debris about hatching time.

Storey's fry picker, founded on Dinsmore's.

Atkin's aerator, for use in a can of fish in transportation by submerging, following drawing up and allowing water to run back.

Exhibited by Mr. Downing:

Downing fry net for removing fry from tank.

Tube for Downing jar.

Faucet to be used in connection with operating the Downing jar.

Auxiliary net for whitefish.

Hatching jar.

Exhibited by Mr. Livingston Stone of Cape Vincent, New York:

Model of new galvanized iron hatching trough of the Whitefish hatchery at Cape Vincent station.

Device for allowing anyone to hatch a few trout or salmon

eggs in the home of any one where there is a pipe furnishing running water. It will be observed that the outlet is directly under the inlet. From Cape Vincent station.

Model of a portable hatching trough, the main point about which is, that a small screw driver is the only tool required for taking the trough to pieces and putting it together again. When taken apart it can be easily carried in a pair of ordinary shawl straps, put in spawning ground in the woods or anywhere else, and set up without trouble or expense. The canvas is supposed to be waterproof, of course, although it is not so prepared in the model.

Exhibited by Mr. Booth:

Long distance asbestos packing case.

Exhibited by Mr. Lydell:

Bass net and screen.

By Mr. Robinson:

Bass nest.

Mr. E. E. Rice, Green Lake station, Maine:

Samples of wire:

- (1) Wire used for fry in rearing troughs.
- (2) Wire used on trays in hatching quinnnet salmon.
- (3) Wire used for brook trout and landlocked salmon.
- (4) Wire used for false wire bottoms.
- (5) Wire used for fingerlings in troughs and rearing ponds.
- (6) Wire used for foot screen attached to wire bottom.

Also (7) Lifters for handling trays in developing hatching troughs.

Developing hatching troughs.

By Mr. Stranahan:

Stranahan dam board.

By Mr. Dean:

Pair fry pickers.

Perforated can top for holding fish preparatory to shipment.

Model of tube with screen in side for general use around station, for holding fish.

Bucket for same use, or messenger shipment. Model especially good for messenger shipment.

By Mr. John L. Leary, San Marcos:

Samples of fish food, including spawn of water snail, shrimp, chopped fish, maggots, crawfish, top water viviparous minnow, water fleas, fish eggs and silverside.

Pictures of apparatus giving idea of how to get water plants out of ponds.

By Mr. G. H. Lambson, of Baird, California:

Directions for making cheap paints, with specimens.

By Mr. Seagle:

The Seagle fry trough with separators.

By Mr. O'Malley:

Box for mixing salt solution for testing eggs.

Box in which eggs to be tested are placed.

Wire egg scoop.

Miscellaneous:

Expansible aerating funnel, from Swanton, Vermont.

White fish and white perch egg strainers.

NOTES ON THE FEEDING OF PARENT TROUT, WITH REFERENCE TO VIRILITY OF EGGS PRODUCED.

BY GEORGE R. ALLEN.

A change in my duties prevented the completion of the experiments set forth in this paper, and it is presented in the hope that some one in a position to do so will continue work along the lines indicated.

The brood ponds utilized for the experiments were each 25 feet long, 12 feet wide, and contained water to a depth of 4½ feet. During the season of 1901 the brook trout in them, at that time six years of age, yielded an average of 1052 eggs per fish, and an equal number of males were stripped to impregnate the spawn. Of the eggs obtained 9 per cent were lost during impregnation.

At the close of the spawning season the fish were divided into two lots. The first lot were given a diet consisting of two parts sheep lights, one part sheep liver, and one part sheep hearts. The second lot were fed solely on dead trout eggs up to April 18, at which time their appetites began to increase. As the supply of dead trout eggs exceeded the number required in feeding, the surplus eggs were frozen and preserved in a refrigerator, the last of them being fed to the fish on June 4. Beginning on April 18 the second lot of trout were given a mixture composed of four parts bran, two parts fish eggs, one part each of meal and sheep hearts.

During the progress of the experiments no salt was placed in the food of the fish or thrown into the ponds. At intervals of once a week a bushel of swamp or wood earth were placed in the spout leading to the second lot of fish and allowed to wash into the pond, the water supply at such times being increased one-third, and on each following day all sediment and decayed vegetation was removed from the pond, thereby giving the fish a second bath. It was noted that on these and the succeeding days they were more active and that their appetites were much keener.

The loss during the year among the first lot amounted to 14 females and 16 males, while that among the second lot was 8 females and 7 males, or exactly half the loss in the first pond. The fish in both inclosures began spawning October 3. Of the first lot 75 females yielded an average of 1021 eggs or 31 less than the average of the previous year; 89 males were used for fertilizing them. Two per cent of the eggs were poor when taken and a further loss of 7 per cent occurred before the date of hatching. The average weight of these fish when placed in the pond was 7-8 of a pound, and at the spawning period it showed no increase. Their color also was somewhat dulled.

The yield of eggs from the second lot of fish showed an average gain of 18 eggs per fish. To impregnate this lot 86 males were stripped. One per cent of the eggs were poor when taken and a further loss of 4 per cent ensued during the hatching period. The fish had gained an average of an eighth of a pound during the year and their colors were brighter than when placed in the pond.

The fish of the second lot produced an average of 49 more eggs per fish than the first lot, and the loss up to the time of hatching was four per cent less. The loss of fish by disease in the first lot also exceeded that of the second lot by 15, but there appeared to be little, if any, difference in the fry hatched from the two lots of eggs.

Nearly all of the fish lost suffered from gill affection. Both ponds during the course of the experiments were kept scrupulously clean, and so far as it was possible the conditions in both were made identical.

POTOMAC BASS.

BY HENRY TALBOT OF WASHINGTON, D. C.

The first object of this Society is "to promote the cause of Fish Culture."

Fish Culture has two groups of beneficiaries—the consumer, together with those who labor for his benefit—that is the commercial side—and the Angler.

It is from the standpoint of the latter that my little contribution is made, and it is fair to say that the term "angler" is used not for the flyrod's 400, but to include every one who catches fish for sport—from the barefooted boy's elder pole to the bamboo whip. It is not inappropriate that you should hear what some of us think of you and besides you need us to supplement your work. All the fish you could put in would do no good if we did not take them out.

It is peculiarly fitting that the Potomac should receive your attention, for to mention that river is to throw bouquets at Fish Culturists. The Black Bass is an alien to that stream, yet he has flourished in its waters as have our forebears on its banks, and as there is no country in the world like our own nation of immigrants, so is there no Black Bass river to compare with the Potomac. Rocky and rushing for three hundred miles of its length it is to the Small Mouth Black Bass as ideal a home as is the Nepigon for the trout or the Restigouche for the salmon. For three score miles below the Little Falls its coves and hundred creeks with the sluggish waters of the tide-water marshes and their wealth of food makes to brackish water, Large Mouth Bass, as suitable homes as do the lagoons and lakes of Florida, and he would grow to as great size even to match that mythical 23-pounder of southern fame—if the fishermen and the anglers would but give him a chance. The latitude is not against him, for I have seen two bass from Peters' Lake, Missouri, a latitude not lower than this, of about 12 pounds, and they have been found here of above nine, but overnetted fish grow small.

It is said the average of shad in the the Potomac were long ago of 14 pounds weight and they do not now reach half that

figure—the wonder is, any are able to filter through the pounds and seines and drifts and dips that dispute their passage from the Capes to the Great Falls. Indeed, they would long since have disappeared as a commercial product of the Potomac but for the wonderful success of the fish culture, which this society does so well to encourage, and in which our Government beats the world. The Chinese, with their eggshells of fertilized spawn knew some tricks of their own before we moved over here, but in these days of railways when a carload of a million of fry may be sent to any corner of our country, eggshells of spawn sounds about as effective as shooting elephants with firecrackers, or using a lightning bug for a searchlight.

You are all familiar with the fact that the Small Mouth Black Bass were planted before the war, at Cumberland, on the Upper River, having been brought over the mountains from Wheeling Creek, in the tender of a locomotive; that the river was then full of suitable feed, and that the conditions which made the Potomac a dead line between the contestants, made angling for some years along its banks an unhealthy occupation, if there had been time to indulge in that pastime. As a consequence the fish spread as never did fish before or since—for never was so effective a close law anywhere else; one that threatened to pull a man's cork under if he showed himself on either side, and when matters settled down and the riparian dwellers had leisure to try the river—to everybody's astonishment—it was found to be teeming with bass. The official reports tell of how all the cities of the East were supplied from here—the Susquehanna and other streams were stocked, and hundreds of fishermen found summer employment and revenue from their capture. Afterwards the efforts of distribution of black bass in my own State of Illinois, proved so successful that the government went into partnership with us, and have since supplied the world with stock mainly from this source, and since this fish resists artificial propagation the arrangement is a fortunate one. These are principally the Large Mouth Bass, and they have been placed in the tidewater Potomac, and the tributaries of that estuary, where they have wonderfully thriven, until, permit me to repeat, there is no Bass stream like it anywhere when the sun is clear, but there is a strange variability of the angler's luck in this river.

Some Small Mouth Bass have been planted in the lower river, and, of course, from time to time, have come down from the Upper River in floods or wanderlust, but they are unsuited to these quieter waters and muddy bottoms, and are not plenty like their cousins, just as the Large Mouth has in later years occasionally been placed in the upper reaches, but do not find it congenial since by then the Carp had found a lodgement in the pools where the Large Mouth Bass might have made a home—and he left in disgust.

The Carp cannot drive the Bass out or disturb his nest (he does not eat the bass spawn, as it is stuck to a gravel so tight he'd have to bolt a ton of pebbles for a pound of jelly); the Carp with his velvet sucker mouth is about as bloodthirsty and ferocious as the rabbit, and probably fights the same way by butting, while the bass will tackle anything that approaches his gravel-pan. This assertion is made without any pretense of superior information—but a conviction born of years of observation—that all the stories of Carp eating bass spawn are pipe dreams—sometimes dreams come true—and somebody may sometime prove that Carp are fond of bass nest soup, and then I shall be in the position of the listener whose friend telling a miraculous yarn wound up by saying "I wouldn't have believed it myself if I hadn't seen it:" and who retorted: "Then, you of course, will pardon me." But while the Carp cannot disturb the Bass spawn-beds, his digging in the mud and clouding the water does disgust the Bass as it does the bait on which he feeds and any other self-respecting denizen of the pools, and the Carp soon has the mud to himself. While what I have to say is assumed to be in the interest of everyone who takes fish with an angle, without regard to lure, my own preference is for the artificial fly—and though making no claims to any superiority for that way of taking fish—and admitting as much skill and pleasure—and science in the other methods—and though under many conditions of cloudy water or deep, the fly is useless—none other appeals to me: and with that introduction I desire to proclaim—what many people will consider a heresy—that in his season the Large Mouth Bass is better sport than the Small Mouth Bass from the warm waters of the Potomac or the chilly waters of

Canada—and in competition with the incomparable trout of the Nepigon.

It is easy to understand why one should fall into the error of disparaging the Large Mouth Bass. Half the good of a health resort comes of the attention to hygienic rules, as easily practiced, but so often neglected at home. Half the pleasure of the summer's fishing trip is the change and effort.

We value most what costs the most and are prone to disparage the cheap no matter how good.

The Large Mouth Bass can be raised in anybody's back yard, and is the best fly taker of any fish that swims—yet nine out of ten anglers at the Capital will assure you that there is no pleasure in taking it, that one Small Mouth will give you more fun than a dozen chub—as they will persist in calling the Big Mouth in Virginia. Strange to say these bass are learning new habits in their new home, and instead of a fixed habitation as we have them in the Western lakes and rivers, the Large Mouth Bass of the Lower Potomac follow the lead of the anadromous fish, and run up the creeks in the spring, maybe for shallow gravelbeds to spawn, and wherever shad or herring are caught or dipped there too they take the bass. As soon as a chill strikes the water in the Fall they make another run from the river, and every small creek becomes literally alive with them—if they are not headed off with nets—just for what purpose this up-stream autumn pilgrimage is made is not apparent. It was thought, to seek the shallows to hibernate, until catching bass the year round rather exploded that theory—or that nearer the springs they found warmer water; at any rate, up they go—and when word comes to town in late September that the fish are “running up” the anglers who never go “down” at any other time, start out. The water is chilled, the fish are sluggish; and deserve anything harsh that may be said of them—so the language is milder than that applied to the men who ought to know better.

The Little Mouth is no better when his element is chilled, and big catches of these are made late in the season in the Upper River when the bait moves off as if it was asleep and the fish comes up as if it was dead.

The fish is a cold blooded animal, and he only gets to be “hot stuff” when his element is warmest.

The Horse Mackerel is found around the world, but it is only at Sunny Catalina that he earns the title of the Leaping Tuna. To see the giant herring cleave the air you must go to the hot waters of the lower Gulf Stream, though these Tarpon have been caught in the Potomac. Even the Trout and Salmon are only lively in the summer months, and the Grayling further north succumbs to a hunk of pork for a lure. Now, if you will do the Large Mouth Black Bass justice to invite his attention when he is at his best, when the bugs are on the water, and the flies are in the air, he'll surprise you with such ground and lofty tumbling as would put a trout to shame. He is not sluggish—he doesn't quit—he'll leave the water higher and oftener; stand on his tail and shake off every drop of water in his effort to void the hook and plays pranks to the boat where the trout would only be trying to bore through to the seat of war.

Then, too, the unwise say he is not good to eat, and there is no better meat with bones, but ninety-nine men out of one hundred still string fish, and a water soaked fish that has died and bleached in the sun on a string in shallow water—such as one may see in any group of anglers—or such fish as the netters send to the markets in hot weather, are scarcely fit for food, and, of course, are not palatable.

If, when you lift the Bass out of the water, you will bleed and draw him, you will find a greater difference over the fish you probably know than between a peach and a horse-chestnut.

In my opinion, no man living can tell whether he has a Small Mouth Bass or a Large Mouth on his line or on his plate from the fight for flavor, if neither has a card, and, confidentially, I lean a "little" toward the one whose smile reaches to his ears. He is so satisfying, and gives such confidence when he comes up after your fly, whether splitting his Nelumbium umbrella in an Illinois Lake, or turning sommersaults at midnight in the St. Francis, or racing a pike for your fly down the Potomac—he's all there and when he gets it—which he's sure to do—he'll come again and again for it, rapture!

But the object of all this is to invite your attention to the fact that for three years there has been no fishing in the Potomac, and to beg you to tell us why? To save you guessing, it may be as well to run over the reasons which have occurred to us:

First, as a matter of course, has been the pollution of the Potomac. Tanneries and pulp mills coolly appropriate the water that comes, and foul the water that goes with as little regard for the rights of others, or the laws of the land, as insurance managers or merger promoters. They pour poisons or shavings into the water, their neighbors must later drink, in a perfectly inhuman way, and with not only a recklessness of consequences, but with a brazen assurance that grows indignant at even mild remonstrance as an impertinence until as an acquaintance commenting on the forced submission to these corporate wrongs, put it: "If nihilism could offer any relief, these fellows are in a fair way of making converts." You cannot appreciate unless you have seen the effect of a couple of pulp mills filling up every pool for miles below with rotting shavings, and then look at a club record with scores up to three years ago that were good enough for anybody, and since then not an entry. The Blue Ridge Club below Harper's Ferry, with some of the most enthusiastic and expert anglers of the Capital, have not made a catch in three years and pollution would seem to be answer enough to the question and probably is for that locality. A paid guide at Harper's Ferry will today point you to pools and tell you the shavings there are thirty feet deep. But too little is known of the effects of pollution even by these scientific sharks whom we are proud to number among our friends—a few experiments have been tried of the effect of putting some fish into a tank with shavings to see how long they would last, but it will require years of investigation and more appropriations than the corporations are like to allow, to determine the effect of these various contaminations upon fish life. It isn't alone whether a bass may live some weeks over a bed of fresh shavings, if he must, but what is the condition of a bed decomposing for ten years? Will the smaller fish the bass eats live? Can he spawn in a poplar mattress? Will the vegetable life exist that is necessary for the tiny brood? What changes in the Plankton result, and what chance has the small fry in a garden of excelsior? By the time these questions are all answered they will have used paper enough to exhaust the forests on that stream, and the mills will have moved. The fact is, Draco's idea ought to be applied to these fellows. He had but one punishment. The smallest

infraction in the law, he said, deserved it, and the greatest could receive no heavier penalty. So of pollution. The limit for any infraction, the smallest deserves it as well as the greatest. But pollution is not enough to explain the strange recurrence of good and bad fishing seasons. It is not seven years of plenty and seven years of famine, but the alternating periods for the last fifteen or twenty years are about five years each. It is overfishing in the good years that exhausts the stock, and must we wait for a re-stocking? Is it exhaustion of food supply that leads the bass to turn cannibal, which he will do under stress, and is it the real race suicide that depletes his ranks till the food supplies again come up? None of these are satisfying theories. There is still another so remote as to excite derision among two classes: Those who know it all, and those who don't know anything. To plant potatoes in the dark of the moon is, with most, a matter of jest, yet there is an Angler's Calendar based on phases of the moon, to which some fishermen are as devoted as the sailor to his needle. But this doesn't help us in the present inquiry, for that calendar only points the best time of the month to fish. What is wanted now, is an answer to the questions, which are the best years to fish, and why?

The periodic recurrence of sunspots has aroused the attention of the scientific world, and a storm of conjecture as to their nature, origin and effects on earthly phenomena. The sum total to date of published information on the subject seems to be as vague on these points as to the whence, why and whither of the *Aurora Borealis*.

But while we are scientifically ignorant of the cause of these spots, their purpose and influence, it requires no F. R. S. to follow their periodicity, and to note the coincidence of certain phenomena. That the maxima are between ten and eleven years may be taken as established.

The territory of the Central United States along the Great Valley of the Mississippi, say in the neighborhood of St. Louis, is subject to overflow that threatens for a series of years, but culminates one year in ten, for instance, in 1893 and 1903, in destructive floods. These are the years of the greatest number of sunspots and with these immediately succeeding are marked by severe winters, and wet cool summers for that parallel, and these

we have regularly, the last three being easily recalled for the Washingtonian. In these years we catch no fish. Now, again, why? It is not a fortuitous coincidence for the fishing of the entire river is affected, and for the last two seasons comparatively no shad were taken in the Potomac so that the andromous fish were also discouragingly scarce. With a remote interest in the largest seine on the river it has been impressed upon me that these seasons have been rank failures, that net has gone nearly bankrupt for lack of shad, and the Commissioner's records will bear out this statement. Again, why?

The long icy season, the cold spring and the chilly water may check the run of shad. It takes sunny days and warm to bring them out on the shallows where the nets are operated. Failing these, the shad, such as run, hug the narrow ten fathom channel and sneak past the threatening webs. But even at that they ought to show in greater form in the upper waters. They were probably more numerous than usual this year at the foot of the Great Falls, the end of their run, but missing millions are unaccounted for.

Now, the Bass fishing in the Potomac from one end to the other has been practically nil for the same period. The flood years are seasons of rain, feed may be washed away, spawn beds may be destroyed, the numerous rains keeping the river muddy, and banks full through the fishing season. The burning question still is: Why is the Bass fishing in the Potomac poor for for three or four seasons in succession corresponding to the sun-spot periods? And may we expect big strings in 1908, the next year of no spots and of drought? A friend in New York who formerly spent his week-ends on the Potomac and is familiar with all its famous stretches recently wrote me of some of his marvelous catches and noted his greatest as made in the season of eighteen years ago—that would be 1887—and would bring 1907 as the coming good year. It is but a corroboration—1907, '8 and '9 ought to be drier and hotter than the last three years, the water being clearer, the pools lower and more fish caught. In each decade are the 3's the poorest fishing and the 8's the best? The question is asked that you may smile if you like, think if you will, answer if you can.

DISCUSSION.

President: There are some pretty hard nuts to crack here and I hope you will proceed to crack them if you can.

Mr. Clark: I think the reader has cracked one nut for me. If the sun spots are "it", that is the reason we did not catch so many white fish as during the year previous. We shall have to lay it to the "sun spots."

FISH PROTECTION.

BY OREGON MILTON DENNIS.

(Secretary and Counsel Maryland State Game and Fish Protective Association.
Assistant State Game Warden.)

Great difficulty is at once apparent, especially to you, gentleman, of presuming to suggest a solution of this great question of fish protection. This condition is brought about, first, by the belief that he, the fisherman, has an inherent and inalienable right of fishery, which has come to him through a long line of ancestry in the same way in which an estate tail operated at common law, and a right which neither his fellow citizens, land owners or the state can take from him, or in any sense abrogate. That the right of the state to legislate for the protection of fish was settled as far back as the Magna Charta is of small concern to him.

The first problem then is the education of the takers of fish as to the right of the state to legislate for their protection and to make him understand and believe that the only interest that the state has in passing legislation for their protection is for his protection, for the state derives no benefit *per se* from the increase of fish in the waters within its boundaries, but the proceeds thereof go directly to the fisherman.

Then again, fish protection does not appeal to the fisherman as does game and bird protection to the hunter and sportsman. The absence of sentiment and the application of the senses of sight and sound which appeal to the aesthetic nature of men as well as of women whose early morning slumbers are brought to an end by the beautiful songs and warblings of the song-birds; the beauty of their plumage to the sight, the steady aim and true aim of the sportsman who kills his pheasant or his quail or his deer or his rabbit—none of these things appeal to the fisherman, who throws his net trusting to Providence or good luck to fill it with the finny tribe—not that any of his senses shall be gratified or his troubled brain soothed by song, but how much will the catch be worth. This is the only senti-

ment that controls the market fisherman. He cares not for his fellowman nor his state, but how much is there in it for him, that is all. Hence the difficulty in enforcing laws, even after proper ones are passed by the state for fish protection. That this sentiment alone controls him and that this is the reason that he will not aid in the protection of fish goes without denial. And even if you try to prove to him that by seeking and taking undersized fish or by the destruction of spawn he will exterminate them, and if he will let them grow, he will secure a larger increase in the revenue from the industry, it is not believed by him. I have used this argument time and time again. A few weeks ago at a trial of some cases at Rock Hall, Maryland, and at which I secured the conviction of a number of fishermen for violating the fish laws, I made this argument: In the Baltimore markets this past spring perch of the size of about eight or nine inches could not be had for less than fifty cents per bunch of six or seven, while fish of a size prohibited by law in our state, to-wit, seven inches, sold and could be had in plenty for some ten to fifteen cents per bunch of eight or ten. I appealed to them on the ground of a cold-blooded financial proposition, showing the difference between securing twelve cents for a commodity which undisturbed would bring fifty cents within a single year, but as usual a deaf ear was turned to all my arguments, and they are at this time daily violating the law.

I do not refer to the angler's destruction of fish in this paper because he plays but a small part in fish destruction, for in my state I really believe that a good haul of one purse net destroys more fish than all the fish taken by all the anglers in a season.

Therefore, while the education of the finer sensibilities of the children, the women and the sportsmen will bring about the natural protection to a large extent of the song and game birds, the market fisherman refuses to be educated on these lines, hence the first problem. The fisherman must be educated on other lines—the mercenary ones. Appeals must be made to his pocket rather than to his heart or brain. He must be taught to believe—which is a fact—that he is killing the goose that is laying for him the golden egg; that he is putting at defiance the better wisdom of the state which passes laws for the protec-

tion of a commercial commodity for his sole benefit; he must be educated up to the fact that fish are the sustenance of life as well as palatable to the taste; that notwithstanding the artificial propagation of fish the state's propagation cannot keep up with his unnatural destruction of them.

From time immemorial the market fisherman has racked his brain to create some device by which he can take the largest number of fish with the least trouble, expense and work to him. From the primeval means of the Indian who used his spear, we have now come to the system of nets, with the use of which, in a short time in many of the states, many species of food fish will be entirely exterminated. The market demands for fish can never at this day be filled with the natural supply, hence I take it that this was the reason that the United States government and the state government inaugurated the artificial propagation of fish and which has resulted in the formation of the American Fisheries Society, when at least once a year its members may get together to discuss means for the better and more effective propagation of fish.

I must plead ignorance as to any solution of this problem of fish protection in any of the states other than my own and the states that adjoin it. Beyond any question of contradiction I claim that Maryland has in the Chesapeake Bay the richest body of water in the world; not only in its finny tribe, but its terrapin, its oysters and its crabs, which are world-famed for their value as well as their deliciousness. At the same time there is less protection in Maryland for these than in any state in the union.

To particularize; almost every net that is used for the taking of fish in Maryland is prohibited somewhere in the state. One county will prohibit the use of a certain net and the adjoining county permit it. Purse netting, the greatest known destructor of small fish, is prohibited in Maryland, but only above a certain line in the Chesapeake Bay.

In 1902, after much labor, the Maryland State Game Association, through its secretary, prepared and passed the bill which is known as "The Fresh Water Bill for the Protection of Bass, Pickerel, Pike, Perch, also known as wall-eyed Pike, California Salmon, Yellow Perch, Rock or Striped Bass, making

it unlawful to take any of these fish of a certain size, to-wit, white perch less than seven inches in length, yellow perch less than eight inches, pike less than fourteen inches, rock or striped bass or tailors less than ten inches, and black bass less than eight inches, and provided further that the season shall be closed at certain times of the year in which these various fish may spawn." One of the fairest bills for fish protection that I know of, admitted to be such by the members of the Legislature who passed it, but notwithstanding the fact that they admitted it was one of the best bills ever presented, the representatives of nine out of the twenty-three counties had it exempted from operating in their counties.

This bill also made it unlawful to have in possession or offer for sale any of the above enumerated sized fish in the City of Baltimore. Now what is the result? I began first to have arrested the wholesale dealers who offered for sale undersized fish. From this began howl No. 1, resulting in the bill going to the Court of Appeals on the ground of unconstitutionality, but which the Court of Appeals sustained.

I then began a crusade against the retail dealers, which brought about howl No. 2. Their chief complaint was that if a fisherman was not permitted to catch fish undersize, then they would have no undersized fish to offer for sale. I then attempted to pursue (and in many cases succeeded) the catchers of undersized fish, but on going into certain counties my hands were tied because that particular county was exempted from the provisions of this bill and I was up against this condition, that while it was lawful for them to catch undersized fish, according to this law, in the waters of their county, it was unlawful for them to take such fish to Baltimore to offer them for sale.

I merely mention this to show the chaotic conditions which are prevalent not only in Maryland, but in other states of the Union, where the local laws of a county are superior to the state laws. Our state has been working for a long while to get a uniform and consistent fish law for the protection of all kinds of food fishes, but without result, and this may be apparent to you when I tell you that there are certainly thirty thousand vot-

ers in Maryland engaged in the fish and oyster industries, and most of these are on the Eastern shore of Maryland. You can draw your own conclusions.

Since my induction in office, April 1st, at a rough estimate I have prosecuted not less than 100 cases of violation of the laws and imposed fines ranging from five dollars (which is the minimum) for each fish, up to one hundred dollars. Nets have been destroyed and confiscated, and notwithstanding all of this, violations are going on and fishermen persist in violating the law, trusting to escape its penalties. On the Susquehanna Flats alone there are to-day estimated to be one thousand fike nets; in the Chesapeake Bay there are vessels daily using purse nets, and in the Chesapeake Bay and its tributaries there are a sufficient number of pound nets, if put in a straight line, that would reach, I was going to say about two hundred miles, certainly a length that would surprise you.

On last Tuesday, the 18th, for the first time in the history of fish protection in Maryland, I succeeded in arresting and taking into custody two schooners with their crews, consisting of thirteen men; four 24-foot yawl boats and two purse nets, one of one hundred and thirty fathoms and the other of one hundred and sixty-five fathoms, but in doing this, which is the greatest stride yet made by the state in breaking up purse netters, I only got two vessels out of a fleet of five.

But I am taking up too much time in this matter. Fish protection in Maryland, as I presume in other states, needs a number of things to solve the problem. I suggest:

First. After the passage of protective laws to provide the authorities who have the protection in charge proper machinery with which to enforce these laws. I mean by this high speed vessels to reach those boats that attempt to escape after being detected.

Second. Pound and purse nets should be prohibited in all the waters of the state without any exception.

Third. Such nets as are permitted to be used should be of a sufficient size mesh to permit the small fish to go through without gilling.

Fourth. Stringent laws should be passed to prevent the taking of any kind of fish at any place during the spawning season.

Fifth. Laws should be made to carry out the above suggestions and to put a heavy penalty for having in possession any net of a size not large enough to permit the free passage of undersized fish.

Sixth. The passage of a uniform law by the states, fixing the minimum size of fish to be had in possession or offered for sale, thus preventing an adjacent state from receiving in its market fish of this prohibited size, which otherwise offers an inducement to the fisherman to evade laws of his own state and prevents the adjacent state from aiding him in its violation by taking from him undersized fish for sale.

Seventh. Putting a heavy penalty on railroad and transportation companies for carrying out of the state fish which are prohibited to be sold within the state.

I believe that the solution of this problem of fish protection lies in these two important features: First, the education of the fisherman along the lines suggested above and, second, the prohibition of certain kinds of nets and the regulation of other nets as to the size of the mesh.

I thank this Society for permitting me to express my views concerning fish protection. I only regret that my experience has not been of such a character as to permit me to make valuable suggestions for the protection of fish that you are striving so hard to increase for the benefit of the people of our state and country.

ON THE PROTECTION OF FISH IN INLAND WATERS.

BY DR. JAMES A. HENSHALL, OF BOZEMAN, MONT.

Next in importance to the proper protection of fish and the replenishing of waters, is the proper protection of the waters themselves and the fish food in them. Indeed, there are those who deem the latter measure of more real and permanent benefit than artificial stocking. They argue that if the waters are kept free of pollution, and practicable fishways established on streams, the natural increase of fishes would render stocking by artificial methods unnecessary. This view seems plausible enough were the primitive conditions of the waters preserved and maintained. But such is not the case, and never will be.

The natural conditions of all waters in the settled portions of our country have been changed. This change has been brought about by various activities that are the result of the so-called advance of civilization. Among them are the various industries of lumbering, mining, manufacturing and agriculture, and the sewage of towns and cities.

In lumbering it begins with logging.

The breeding grounds of the trouts and graylings are in the tiny streams forming the headwaters of creeks and rivers. In their primitive state they were in the midst of coniferous forests, in whose solitude and shade the banks and borders of these rills and rivulets were clothed with a dense tangle of verdure, consisting of mosses, ferns and semi-aquatic vegetation. The spongy soil was saturated with moisture that not only maintained and replenished the small streams, but favored the reproduction of the larvæ of myriads of insects, and the minute crustaceans and mollusks, that formed the first food of the baby fish.

Then these secluded precincts were invaded by the lumberjack with his axe. The forest soon disappeared, the gloom and cool shadows of the arboreal recesses were dispelled by the admission of the scorching rays of the summer sun, and the hot, dry winds of the highlands; the moisture was dissipated, the

vegetation shriveled, while the streamlets dwindled and finally disappeared entirely during the summer months. With these changed conditions went the food of the young fry. The breeding trout failing to reach the old spawning places in the autumn were compelled to utilize the gravel beds lower down the stream, where the food of the young fry existed in but limited quantity.

Then with the melting of the snows came the spring rise, and with it the logs of the lumberman, plowing out the beds on the gravel bars, scattering the trout fry and killing many. In Michigan, in each recurring spring, the logs plowed up the spawning beds of the grayling, destroying the ova almost entirely for many seasons. To this cause, alone, is to be charged the almost total extinction of grayling in Michigan waters, and not to over-fishing. Neither have they been driven out by the trout, as has been alleged. Before the era of logging trout and grayling had existed for all time, and dwelt together in perfect amity.

The mining of metals and the smelting of ores can not be operated without water, consequently the streams in the neighborhood of mines become discolored and impregnated with deleterious matter that destroys, utterly, the food of fish fry, covers up the spawning beds with silt and debris, and eventually pollutes the stream to such an extent that but few, if any, mature fish can survive in them.

The offal from distilleries, and the sawdust from sawmills, likewise settles on spawning beds, so that if any fish eggs are deposited they are smothered and the embryo perishes. Chaff from the slop of distilleries and sawdust from the mills often become lodged in the gills of mature fish, causing inflammation and death.

Coal mining is also fatal to fish life, inasmuch as the washing of coal, as now practiced, not only discolors the water, but the coal dust is deposited on the spawning beds, and if breathed in by fish, old or young, clogs the gills, and from the well-known hardness of carbon, irritates and inflames them.

The waste matter from oil refineries, paper mills, starch factories, etc., where poisonous chemicals or noxious substances are used or occur as by-products, is very destructive to fish of

all ages, and is a more potent factor in the destruction of fish food than any agency mentioned.

All of you are doubtless familiar with the loss of fish life from the causes enumerated, but there is a source not generally suspected that is the cause of untold havoc and destruction, whereby millions of fish and fry perish annually. This is all the more lamentable as it could be so easily prevented. I allude to the wholesale destruction of fish life through the operation of irrigation ditches. It is very discouraging to fish culturists in the western states, after hatching and rearing fry and yearlings with much care, labor and solicitude, to have them stranded on the meadows and grain fields of the selfish or thoughtless rancher. It seems to be impossible, by argument or reasoning, to impress the average legislature in the west of the importance of screening irrigation ditches at the intake. The only objection raised is that it would be too much trouble, or take too much of his time, for the rancher to keep the screen clear of leaves and trash. This objection, however, is a mere subterfuge, for during the season of irrigation in the summer the streams are free of trash.

But to meet and overcome this objection I devised a very simple affair, as some of you may know, that would be just as effective in keeping fish out of the ditches as a screen, and one that would need no attention after being put in place. It is an eight-bladed paddle wheel of simple and inexpensive construction, to be placed in a short flume at the intake of a ditch, with enough fall to create sufficient current to operate the wheel. No fish will pass it while it is in motion. Its cost is but little, if anything. But were its use compelled by law it would deprive the rancher of his winter supply of salted trout, and of a valuable fertilizer in the shape of trout fry.

I have made two efforts to have the use of the device made compulsory by incorporating such a provision as a section of the game and fish laws of Montana. But both times the committee on game and fish cut it out for the reason that it might jeopardize the rest of the pending bill, the principal feature of which seemed to be to create a fund for the payment of the game wardens. As the present law now stands, a resident of Montana must procure a license to fish, and pay for it; but in-

asmuch as the same law provides no adequate protection for fish, this tax is generally looked on with much disfavor.

The only protective measure for fish in Montana is that the sale of trout and grayling is illegal. Were it not for this provision the average rancher would have a cinch, for the town markets would be glutted during summer and fall with trout and grayling scooped out of his irrigation ditches.

In view of the extensive schemes of irrigation contemplated in the arid regions of the west by the national and state governments, the proper protection of fishes should be provided for in advance: after awhile it will be too late. Last month a big irrigation canal, constructed by the government, was opened, having its source in the Truckee River, in Nevada. Government and state officials were present to celebrate the event. One account says:

"The gates of the dam were lowered and those of the canal were raised, the great flood pouring into the huge ditch. The reclamation project in Nevada was then formally dedicated. When the gates on the river dam were lowered the bed of the stream below was dry. In an instant the party found diverting sport in catching the large trout that were floundering on the rocks."

The protection of fish by law in many states is mostly on paper. Taking fish during the spawning season, or by means of nets, the spear, and dynamite, and the slaughter of the innocents by the conscienceless angler, are not rare occurrences. In some states where the laws for the protection of game-birds and mammals are rigidly enforced, and but little illegal shooting is done, the laws for the protection of fish are frequently violated. It is popularly considered not so great an offense to take a trout or a black bass during the close season as to shoot a quail or grouse when prohibited by law.

In the older states, where game-fish have become scarce, there is now a disposition to provide stringent laws for their protection, another instance of locking the stable door after the horse is stolen. But on the other hand the equally important matter of protecting the water itself, and the fish food in it, is seldom thought of or sadly neglected. It is popularly supposed that fish should abound, thrive and multiply, wherever there is

a reasonable amount of water, even if polluted or contaminated by deleterious matter which is destructive of fish food, if not of the fishes themselves. Sometimes the mistake is made of dumping fry or yearlings in the main body of streams or the open water of ponds or lakes, where but little fish food exists, and where they are soon taken in by the larger fish.

It has been said that the proper way to train a child is to begin with its grand-mother. So the proper way to protect fish of inland waters is to begin with the water itself. Practicable fish-ways should be placed in every dam or other obstruction. Manufacturing plants and mines should be compelled by law to construct settling ponds for waste liquid products, so that the overflow would consist of comparatively innocuous water. In all states where irrigation is practiced, laws should be enacted providing for some effectual device for keeping fish and fry out of the ditches. Close seasons for all game—and food-fish during the breeding seasons, should be established, and severe penalties should be exacted for the violation of such laws. Every peace officer, or officer of the courts, should be made a game and fish warden with full powers, in addition to the regularly appointed wardens.

The sewage of towns and cities is another problem that will have to be dealt with eventually, though at present it receives but little attention. If these things can be accomplished better in the future than they have been in the past, and more care be taken in stocking waters with fry or yearlings by depositing them in the smallest tributaries, or shallow, protected places, where there is a reasonable amount of food suitable for them, we will be on the road toward a better state of things, so that by the continual stocking of waters with fish artificially propagated, a fair amount of fish life may still be maintained in inland waters.

I consider that it should not only be the privilege and pleasure, but the duty of this Society, individually and collectively, to employ every means to educate the people to a proper sense and appreciation of protective measures, not only for fish, but for the waters as well, and to use its influence in shaping such wise, adequate and effectual legislation as may be necessary to that end.

As the Department of Agriculture has begun the good work of protecting and conserving our game-birds and mammals, the question naturally arises: Why should not Federal protection be extended to our fishes in public waters? I can imagine no good reason why the United States Bureau of Fisheries should not take an active interest in preventing the pollution of public waters, and in protecting the fishes that inhabit them. In anticipation of the extensive irrigation projects contemplated by the general government in the western states, the influence and timely action of the bureau would prevent the almost total depletion of the streams of fish life which would otherwise surely follow.

DISCUSSION.

President: In the report of Dr. Henshall's paper read yesterday at the hatchery, Mr. Clark has discovered what he claims to be some inaccuracies, and he would like to state them and have them corrected, so as to have it go into the published proceedings all right.

Mr. Clark: It is unfortunate that the paper of Dr. Henshall on "The Protection of Fish in Inland Waters," could not have been read in full before the meeting. It was read before the gathering down at the hatching station, when very few were present, and in fact I believe part of the paper was not read at all. Since that time I have had the privilege of reading his paper, and after going over it quite carefully, I think it worthy of very careful consideration.

Dr. Henshall says in his paper: "In Michigan, in each recurring spring, the logs ploughed up the spawning beds of the grayling, destroying the ova almost entirely, for many seasons. And to this cause alone, is to be charged the almost total extinction of the grayling in Michigan waters, and not to over-fishing. Neither have they been driven out by the trout, as has been alleged. Before the era of logging, trout and grayling had existed for all time." I wish to call attention to the fact that in printing the paper that way without making any explanation, it would seem as though the Michigan and the United States Fish Commissions had practically nothing to do with these streams, so far as stocking is concerned. It is not a fact that the grayling

streams had trout in them. In my first fish cultural work thirty years ago, the streams that contained grayling were barren of trout, and the latter were not there until planted. I want to emphasize the fact that the best streams today in Michigan are those that have been stocked by the state and Federal Fish Commissions. That point I want to bring out clearly.

Dr. Henshall further says: "All of you are doubtless familiar with the loss of fish arising from the causes enumerated, but there is a source already suspected whereby millions of fish and fry perish annually. This is all the more lamentable as it could be so easily prevented. I allude to the wholesale destruction of fish life through the operations of irrigating ditches."

And further on: "As the Department of Agriculture has begun the good work of protecting and conserving our game birds and mammals, the question naturally arises: whether or not federal protection should be extended to our fishes in public waters. I can imagine no good reason why the United States Bureau of Fisheries should not take an active interest in preventing the pollution of public waters, and in protecting the fishes that inhabit them. In anticipation of the extensive irrigation projects contemplated by the general government in the western states, the influence and timely action of the Bureau would prevent the almost total depletion of the streams of fish life which would otherwise surely follow."

I think that this society ought to take some official action, now that the irrigation matter has been taken up so extensively, to urge upon the various states and the national congress to do something along the line of fish protection. I can see the point Dr. Henshall makes further back about the gates being opened and the trout rushing down and scattering out and all dying. He gives a plan there that he thinks will remedy the difficulty easily, and I believe it is a matter that should be thoroughly investigated. Undoubtedly in time an effort will be made to remedy the trouble; but it is urged that something be done now, before the streams are greatly injured.

Mr. Fullerton: I suggest that Mr. Clark present a resolution to be acted upon in that line.

Mr. Seymour Bower: I wish to endorse all that Mr. Clark

has said in regard to the distribution of trout and grayling naturally, in the state of Michigan. The inference to be drawn from Dr. Henshall's paper, as I understood it yesterday, was that the trout and grayling inhabited the same waters indiscriminately. According to our best information that is not true. The trout belt and grayling belt of Michigan were clearly defined. The great natural trout belt of Michigan was the upper peninsula, and there is today and never has been but one grayling stream in the upper peninsula, viz., Otter river. The great natural grayling belt was in the lower peninsula; and these streams contained no brook trout. Those that contained the grayling had no brook trout naturally, except possibly a few where the dividing lines nearly joined; but practically the grayling streams contained no trout, and vice versa. Today, of course, grayling are practically extinct, but the streams are all now strictly first class trout streams, made so through the introduction of fish from the hatcheries.

Mr. Titcomb: I want to ask a question on that point. Was the depletion of the grayling caused by the introduction of the trout?

Mr. Bower: That is a mooted question. Dr. Henshall says it is principally through the running of logs destroying the spawning beds. But the introduction of trout is a factor at least. Of course the introduction of any kind of fish where there is only one variety, as there was practically in the case of grayling, would supplant the single variety to a greater or less extent. My own opinion is that those streams will never be restored as grayling streams because they are stocked with trout.

Mr. Titcomb: On Mr. Clark's reference to Dr. Henshall's paper, and the effects of irrigation on the fishing, I think that matter is just as important as the protection of the Yellowstone Park, and I think there should be some action, state or national, or both, in that respect; and I believe that a resolution should be drawn by the resolutions committee on that subject. I get reports from other sources than those to which Dr. Henshall has access, from other superintendents and persons applying for fish; I note that the irrigation situation is growing worse and worse every year, and extending from one place to another. Even

in Colorado where the trout has obtained such a foothold since the artificial propagation has been taken up there, we face the evil results of irrigation. The stock of blue back salmon has disappeared from the Columbia river, a fact which is largely due to irrigation in the head waters. Dr. Evermann can vouch for that.

Dr. Evermann: I think that is true, although I have made no personal observation on that point; I have been told by people in various places in the Snake River Basin, that the young blueback salmon go down during the spring floods, and in immense numbers run up into the irrigating ditches; and I know the same thing to be true in certain places in Colorado as to trout; but as to the fact regarding the blueback salmon, I am not personally conversant with them, though I have no doubt that irrigating ditches in the west are a very serious factor in the destruction of the various Salmonidae in that region.

President: It seems to me that the importance of this subject requires especial attention. Perhaps the committee on resolutions have not time to take this thing up and present it in shape to be effective. It seems to me that there should be a special committee to look into that matter and draw strong resolutions. If the committee on resolutions have the time and can get the testimony they want and incorporate it, that is all right; but I have heard no motion to take the matter up and refer to the committee on resolutions.

THE GOLDEN TROUT OF VOLCANO CREEK.

BY DR. BARTON W. EVERMANN, OF WASHINGTON, D. C.

I shall take but a few minutes to tell something about the Golden trout of Volcano Creek, California. There was not very much known about this very interesting species of trout until recently. Up to 1875 nothing whatever was known regarding the trout of the Southern High Sierras. In that year certain specimens were collected from the south fork of the Kern River, and identified as the common rainbow trout. Nothing more was known from 1875 until 1891, when members of the Biological Survey of the Department of Agriculture and certain gentlemen living at Lone Pine, in California, collected specimens of trout in this region.

The locality is southeast from San Francisco, 250 to 300 miles. It is the culmination of the High Sierras, Mt. Whitney, the highest mountain in the United States, being within this region; and the streams to which I have referred nearly all have their headwaters in and about Mt. Whitney and its neighboring peaks. Just over the divide is Owens Lake, in Inyo county and east of Tulare county. Volcano Creek is due west from Owens Lake.

In 1891 certain gentlemen at Lone Pine collected specimens of a trout and sent them to the Nevada State Fish Commissioner, who forwarded them to the California State Fish Commissioner, San Francisco, and they finally fell into the hands of Dr. Jordan of Stanford University, who described the fish as a new species.

Nothing more was known of the fish until recently. Two years ago, Stewart Edward White, the author of the "Blazed Trail," called the attention of the President to the trout of Volcano Creek, and the ease with which it might be exterminated. He stated to President Roosevelt that this trout is found only in one creek; that while it is abundant in that one stream, the number of tourists who go in there each year will be sufficient, unless some precautionary measures are taken, to exterminate

the species. And as he thought the extreme beauty and game-ness, and interesting features of this trout, merited that it should receive some protection, he urged that this protection be given. In response to these representations the President of the United States asked the Commissioner of Fish and Fisheries to have some inquiries made regarding the golden trout and the possibilities of its extermination; and it was in carrying out the commissioner's wishes that I had opportunity to go into this region a year ago.

The Kern River region is exceedingly interesting in its hydrography. There is one large river, the Kings, flowing west; another, the Kern, flowing due south for many miles of its course; and bisecting the angle between them, is the Kaweah River, flowing to the southwest. We went up the south fork of the Keweah River, examining it in different places, finding trout, and finally coming to the headwaters of the tributaries of the Little Kern, where we found trout not previously collected by anyone. Then we went over the Western Divide of the Sierras to Kern Lake, and there obtained specimens of the Kern River trout, a species of rainbow that had been known since 1893, and a very beautiful species it is. From there we went up Kern River, crossed it and followed up Volcano Creek, formerly called Whitney Creek, on the supposition that it had its headwaters on the slope of Mount Whitney, but that was a mistake. The name Whitney Creek was then transferred to another creek, which rises on the west slope of Mount Whitney, and the other creek was given the name "Volcano Creek," which had been applied to it to some extent before, owing to the presence of some five or six small volcanic cones along its course. From Volcano Creek we went north and followed up Whitney Creek to its head and examined other streams and lakes further north.

Kern River flows through an exceedingly deep canyon, having from 2,000 to 4,000 feet of wall on each side. It also flows exactly south for a number of miles of its course. The streams which come into Kern River from the east and west, come down from the high mountain plateau on each side and drop into Kern River over considerable falls. In nearly all instances the falls are so great as absolutely to prevent the ascent of fishes.

Those falls, of course, through the wearing down of the rock, have come into existence gradually, and such of these lateral streams as are peopled by fishes were doubtless stocked before these falls became impassable. But in some instances the falls became impassable at once, before the streams were stocked, and as a result there are no trout or fish of any kind in many of them. In fact, the majority of the east and west tributaries are entirely without fish, although every indication points to the fact that they would be exceedingly well adapted to trout. And this is one of the good fields for fish cultural work, either by the Bureau of Fisheries or the state of California, that is to say, taking fish from streams where they are found and planting them into these barren waters.

On the west side of Kern River is the Little Kern, which has trout in a number of its tributaries. We found them in Soda Creek, a small stream, and learned that they had been transplanted by ranchers over to the headwaters of the south fork of the Kaweah, and we found the trout in these two places identical.

On the east is a stream called the South Fork, and just north of it is Volcano Creek, the stream of most interest to us, flowing nearly due south, and then making an abrupt bend to the westward. At the point where it makes a bend to the westward it comes within a few rods of the south fork of the Kern, but there is a broad alluvial ridge separating them now. Volcano Creek drops into Kern River canyon over at least three very considerable falls, ranging from eighteen feet to sixty-three feet in height, and it is impossible for fishes to get up over any of them.

Throughout the entire length of Volcano Creek is found this golden trout of Volcano Creek. Doubtless the trout of that creek came originally from Kern River, and it will interest all of you, I am sure, to compare the Kern River trout, the Volcano Creek trout, and the one from Soda Creek. The Kern River trout, or Gilbert trout, is profusely spotted throughout; it has a rich, rosy wash on the side. Between the rami of the lower jaw there is sometimes a slight wash of red, but ordinarily not. The important point is that they are so profusely spotted all over, with the anal, dorsal and ventral fins white tipped,

somewhat as in the common brook trout, but it is not a *Salvelinus*, but a *Salmo*.

In Soda Creek and other tributaries of the Little Kern, and perhaps some other streams on the west side of Kern River, is found a species which differs very materially from the Kern River trout. However large the individual may get, they always retain the parr marks, but the spotting is not nearly so abundant as in the Kern River trout, although it extends the full length of the side above the lateral line, covering that completely, and below the lateral line to perhaps half way down the side of the body. The lower half of the side of the body is a rich lemon or orange color, and the belly has a very broad rich orange or cadmium band. It is a small creek fish which never reaches a large size. It is not related to the Dolly Varden.

Secretary Peabody: What is the extreme size of the Kern River trout?

Dr. Evermann: The largest one I caught weighed three and a half pounds. It is a splendid game fish, and it puts up a great fight. It is said to reach a weight of seven or eight pounds.

On the east side in the South Fork of the Kern, is the fish that President Jordan described several years ago, which is very much like Soda Creek trout, with no spots below the lateral line, but is spotted above the lateral line.

Then there comes the *real* Golden Trout found in Volcano Creek, which has scarcely any spots anywhere. The dorsal and caudal fins are profusely spotted, as in all the other cases, but on the body typically there are no spots, excepting on the caudal peduncle, extending no further forward than the adipose fin. The rest of the body and head are entirely without spots. The Parr marks persist in specimens eleven and a half and twelve inches in length, that I have seen. The scales are exceedingly small, smaller perhaps than in any other known species of trout, although the counting does not show it, but that is because the scales are not imbricated, but separated with interspaces between. But even allowing for that, there are at least 200 in a series along the middle of the side. Then the richness of the side, and the extreme richness of the broad cadmium band on the belly, are worth nothing.

Now just a few words regarding the fish cultural value of this golden trout. In the first place, as I have already said, it is an exceedingly beautiful trout. In the second place, it is an exceedingly game fish. Unfortunately it will take any sort of lure, and therein lies the danger of its extermination. Many camping parties go into the Kern River canyon every season. While I was on the creek a period of two or three days, there were several parties, composed of from two to eight people, encamped on the creek. They were fishing all the time, and I was sorry to see in the "Outlook" that one man, who should have known better, as he is professedly a friend of game and fish protection, admitted that his party of three ate sixty of these fish for supper. That is more than our entire party of ten people took in three days for table purposes and for specimens.

Secretary: What is the temperature of the water?

Dr. Evermann: About 53° to 55° F., when we were there, just a year ago to-day.

The golden trout is a hardy fish. Some years ago the California Fish Commission took a number of specimens out by pack train from the creek, a long day's pack down the Lone Pine, and then by rail around to San Francisco, to the hatchery at Sisson, and they reached there with scarcely any mortality. But soon after the fish reached there they died on account of defective water supply.

Last spring a Sportsman's Association of San Francisco, which was having an exhibit, sent a man to Cottonwood Creek, and he got forty or fifty specimens of the closely related species found there; and they reached San Francisco without the loss of a single individual, and remained in the aquariums there for several weeks, without loss, and finally were taken to the hatchery at Sisson, where some of them still remain. The Bureau of Fisheries made an attempt last spring to get trout out from Volcano Creek for the Portland Exposition, but an accident happened to the fish after leaving Lone Pine, and the attempt was unsuccessful. But everything that we do know about the golden trout, indicates that it is a hardy fish and can be transported easily, and no doubt would do exceedingly well in our smaller mountain streams, particularly in various places in the west. I do not know if it would do so well in any of the New

England streams, but it would be exceedingly interesting, I think, to take some of the fish from Volcano Creek, and make a plant of them in some small mountain stream in the east, and note the effect it would have upon the coloration. Of course the peculiar colors of the fish are due largely, or wholly, to its environment, and the environment of its ancestors. Volcano Creek is made up largely of granite sand, gravel, volcanic sand, and volcanic tufa, which resulted from various volcanic eruptions occurring here, all of which have a yellowish white color, and in many places the bed of the stream is yellowish white, and when these fish are lying close to the bottom it is sometimes difficult to extinguish the fish if it is quiet, from the general color of the bottom. But that is what you would expect, as just such factors as those have had much to do with the colors of all fishes and other animals.

There are two ways of getting to the Kern River. A good way is to go by the Southern Pacific, or Santa Fe to Visalia, then by stage to Redstone Park or Threerivers, and outfit there. If you go for angling you will get two or three introduced specimens, the common rainbow, the Shasta rainbow, and the cut-throat trout, also the Soda Creek trout, the golden trout of Volcano Creek, and the golden trout of the South Fork of the Kern. You will find a larger number of fishes, and in a setting perhaps not surpassed anywhere in the United States, for beauty and grandeur.

I should like to repeat again, and there is no field that I know of where fish cultural operations can be extended to better advantage than in the headwaters of the Kern, and certain headwaters of the Kaweah and Kings Rivers. There are large numbers of small mountain streams, and high mountain lakes, which are well supplied with trout food, and which are now entirely without fish of any kind, and these regions are sure to come into greater and greater prominence year by year, as more tourists go there.

Ordinarily it is said that it does not rain in this region in the summer time, and we went in taking that statement at its face value; but it rained on us every day for fourteen days, but fortunately the majority of the rains were not heavy enough to cause us inconvenience.

A report upon this golden trout and its relatives, will be published by the bureau shortly.

(Great applause.)

DISCUSSION.

Mr. Clark: As Mr. Ward Bower is here, and as he brought out the trout to take to the Portland Exposition, I would like to have him describe to the Society, how he brought those fishes from the creek to the railroad point.

Mr. Ward Bower: Mr. President, I do not know that I can say anything of interest in this matter, as I had no intimation that I was to be called upon, but in company with a party that camped on Volcano Creek this spring, we had no difficulty in catching the trout with hook and line; in fact, one man went out in three hours fishing in the forenoon took 166 with a hook and line, with a small piece of bacon for bait. They would take most anything. Even a bare hook, I am quite sure, would catch the golden trout at times. We first attempted to take them in a seine, but were not successful. We found no difficulty in holding them. Our object was to obtain eggs, but we found we were too late. The fish had spawned.

There is a direct trail from Lone Pine over to Volcano Creek—a distance of thirty-four miles, to where we established our headquarters, but owing to the height of the pass, about 11,000 feet, where it is necessary to cross in order to take this direct trail, and to the depth of the snow (this was on May 25th) we were forced to take a roundabout trail, requiring four days' time and a journey of sixty miles, crossing the divide at an elevation of 8,000 feet. Although supposed to be the easier though longer trail, it was necessary to make numerous detours on account of the snow and the bogs.

After getting fish and holding them for a time, and finding it impossible to obtain eggs, we started down for Lone Pine with them, by the direct or shortest trail, the object being to transport them to Portland for exhibition purposes. We had rectangular pack cans that were made especially for carrying fish by pack train, loaned by the California Fish Commission. The train included five men, ten animals, a live car, cans, etc.

The cans held about nine gallons each, and were carried two

cans per mule, one suspended on either side. In each can we placed fifty to seventy-five specimens; on an average they were eight or nine inches in length. We started one morning from Volcano Creek, and the first day traveled eighteen miles, camping that night on a small stream. Here the fish were transferred to the live car, which was placed in the stream over night. The next day, after an unusually difficult half-mile climb to get out of the creek canyon, we continued our zigzag course down the mountains, descending about 6,000 feet the first ten miles, and arriving at Lone Pine that night. We lost ten trout on the journey. It was necessary to change the water occasionally, and also to add snow to keep the temperature down. The sun was very warm during the middle of the day, although the altitude was still high.

One of the cans was covered with three thicknesses of burlap and kept wet. The temperature in this particular can averaged six degrees colder than the others throughout the entire journey. Perhaps some insulation of this kind may be of use in transporting other kinds of fish.

We experienced some difficulty in the loss of water from the cans, some of which had only a screen wire cover. The country being very rough, the water splashed out and had to be replenished whenever possible. I would advise, in the future, the use of a tight cover with perforation. We delivered the fish in good condition to a messenger of the bureau, who started with them for Portland.

THE PROBLEM OF LOBSTER CULTURE.

Experimental Work of the Rhode Island Commissioners of
Inland Fisheries.

BY A. D. MEAD, PROVIDENCE, R. I.

Some years ago the Commissioners of Inland Fisheries of the State of Rhode Island began an investigation of the problems connected with the growth, distribution, and abundance of lobsters, clams, and other shell and food fish of the state. For the last five years particular attention has been paid to the lobster, as the lobster fisheries of the state are exceedingly important and at the same time so extensive as to threaten the total extermination of this delectable food animal.

At the suggestion of Dr. H. C. Bumpus, then one of the members of the Rhode Island Commission, an attempt was made, partly in collaboration of the United States Bureau of Fisheries, to rear lobster fry in sufficient numbers to preserve, or if possible to increase, the supply of lobsters.

For a long time the hatching of lobsters has been carried on artificially by the United States Bureau of Fisheries, but attempts to rear the fry to a size where they can protect themselves and stand some chance of surviving when put overboard, have repeatedly been considered by fish-culturists and biologists, but appeared to present insurmountable difficulties, as all attempts to retain the fry for any length of time in the hatchery proved futile, the mortality being exceedingly rapid.

It hardly seems as if the mere hatching of the eggs would at all increase the number of lobsters, in fact it almost seems as if it would be better to allow them to hatch naturally. The eggs have few enemies, are well protected when attached to the underside of the female lobster, and have every chance of hatching into fry. But the early stages of the fry are unprotected, they swim at the surface and are eagerly sought after by nearly every fish that swims. The real problem of lobster culture is to protect these early fry, to rear them to a stage where they seek the bottom, and hide under stones and weeds, and burrow in the gravel, where they are protected from their enemies and stand

a chance to grow into adult lobsters. In this way only can we hope to decrease the usual natural mortality which is estimated amounts to about 999 in every thousand. This was the problem laid out for the Commission by Doctor Bumpus, and this is the problem which has been carried out to a successful solution.

As has already been said the eggs need little or no protection except from man. The mother lobster securely fastens them to the appendages of the under side of her body, carries them safe protected for many months, continually aerates them by the movements of her appendages, and as they slowly hatch, scatters them widespread as she moves about from place to place. Most states recognize the importance of protecting the egg-bearing lobsters. Laws are on the books imposing a penalty for taking, having in one's possession, or selling them, and if a careful inspection by deputies with power of arrest and prosecution is made, a certain protection will be afforded. It is needless to say that at the present time the strict enforcement of these laws is impossible and that many of the short and "egg" lobsters caught, are not returned to the water.

The newly hatched fry, however, are at once the victims of circumstances. They float helplessly about with every shifting current. Everyone who has studied the subject at all has admitted that the early stages of the fry are the critical stages of a lobster's life, and could they be protected and permitted to grow to the stage where they change their habits, seek the bottom and burrow in the sand, the problem of the lobster culture would be solved.

The little lobster which hatches from the egg begins to eat immediately, grows but little until it is about three days old, when it sheds its skin and becomes a considerably larger second stage fry. It remains in this stage on an average four or five days when it moults and grows again and becomes a third stage fry. Again after five or six days it again moults and becomes a fourth stage fry. It is during this stage, that it changes its habits from a free-swimming larva and takes to the bottom to assume the habits of a full grown lobster. The whole process, varying with many factors such as temperature, food, etc., takes from eleven to twenty-one days.

The difficulties connected with rearing the fry to this later

stage are in brief, first, their terrible cannibalism, second, the difficulty of keeping them properly aerated and free from fouling from their decaying food, third, the supply of proper food, fourth, protection from a growth of diatoms and other vegetable and animal forms, which appears on the surface of their bodies and prevents them from swimming and feeding. To combat and overcome these difficulties one by one has been the work of the Rhode Island Commission for the past few years. I will try to review briefly how this has been done.

In 1898 Dr. H. C. Bumpus commenced a series of experiments at Woods Holl, and in 1900 some of them were transferred to the house-boat laboratory of the Rhode Island Fish Commission at Wickford. Up to this time a great many devices for enclosing the fry were tried, and proved to be impracticable, and the one which finally promised the best results was a scrim bag, suspended in the water so that the movements of the tide and wind would frequently change its shape and prevent the fry from collecting too densely in any one place. The meshes of the scrim, of course, allowed a free circulation of water through the bag; but even in this apparatus, when the weather was calm, the lobster fry, together with unused food, would settle into the pockets which were made by the weights necessarily used to keep the bag under water. When the weights were taken off, the least wind would blow the bag out of the water, and this was very trying to the young lobsters. Near the end of the season of 1900 a new principle was applied, on which has depended in a large measure the success of the subsequent work.

After the numerous experiments and watching the results for about five weeks, the conclusion was reached 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 at the laboratory was divided into watches, and the



water in the bags was thenceforth stirred with an oar continuously for six days. The results was ample proof that the conclusion was correct. There were two lots of lobsters which received this treatment. Neither of these lots was considered to be as promising as the average. However, from one there was obtained 748 lobsters in the fourth stage. This is a larger number than were obtained in any other experiment, either at Wickford, Woods Holl or in any other station where lobster culture has been tried, so far as I am aware. From the other 319 were obtained in the fourth stage; but as one of the bags was old, and had a hole in it, the figures fail to give a correct idea of the results of the experiment. 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.

During the following seasons this experiment was followed up with others, working upon the same theory, namely, that the water should be constantly stirred. To do this it was necessary to invent a mechanical device which would take the place of the oar and designs for such an apparatus were immediately made.

The mechanical device was put into successful operation in the season of 1901 at Wickford. The apparatus consisted of a number of rotating horizontal paddles, similar to those in use over restaurant tables for circulating air, one in each bag, run by a gasoline engine. The movement of the paddle blades created a constant upward current of water in the bags, which kept the fry off the bottom and kept the food suspended in the water. Through its use 9,000 lobsters were raised to the fourth stage, and in some experiments 50 per cent of the newly hatched fry were carried through to this stage. That this was a decided step in advance of the old methods will readily be admitted by those who have followed the course of previous experiments.

The apparatus now used (1905) comprises a house-boat between the pontoons of which are three small hatching bags 6 x 6 x 4 feet, made of canvas; two side floats constructed of 6 x 6 in. spruce beams bolted together and buoyed by barrels, each supporting five large canvas rearing bags about ten or eleven

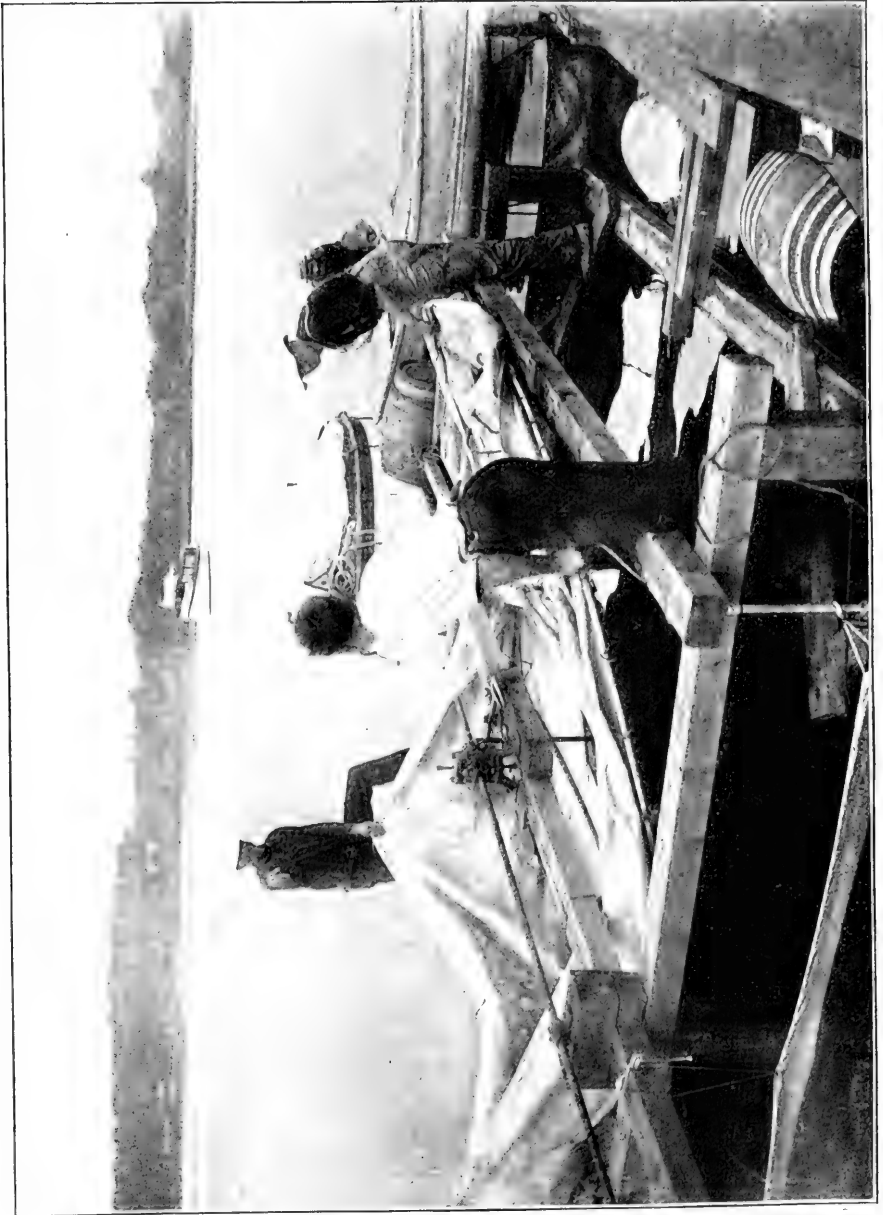
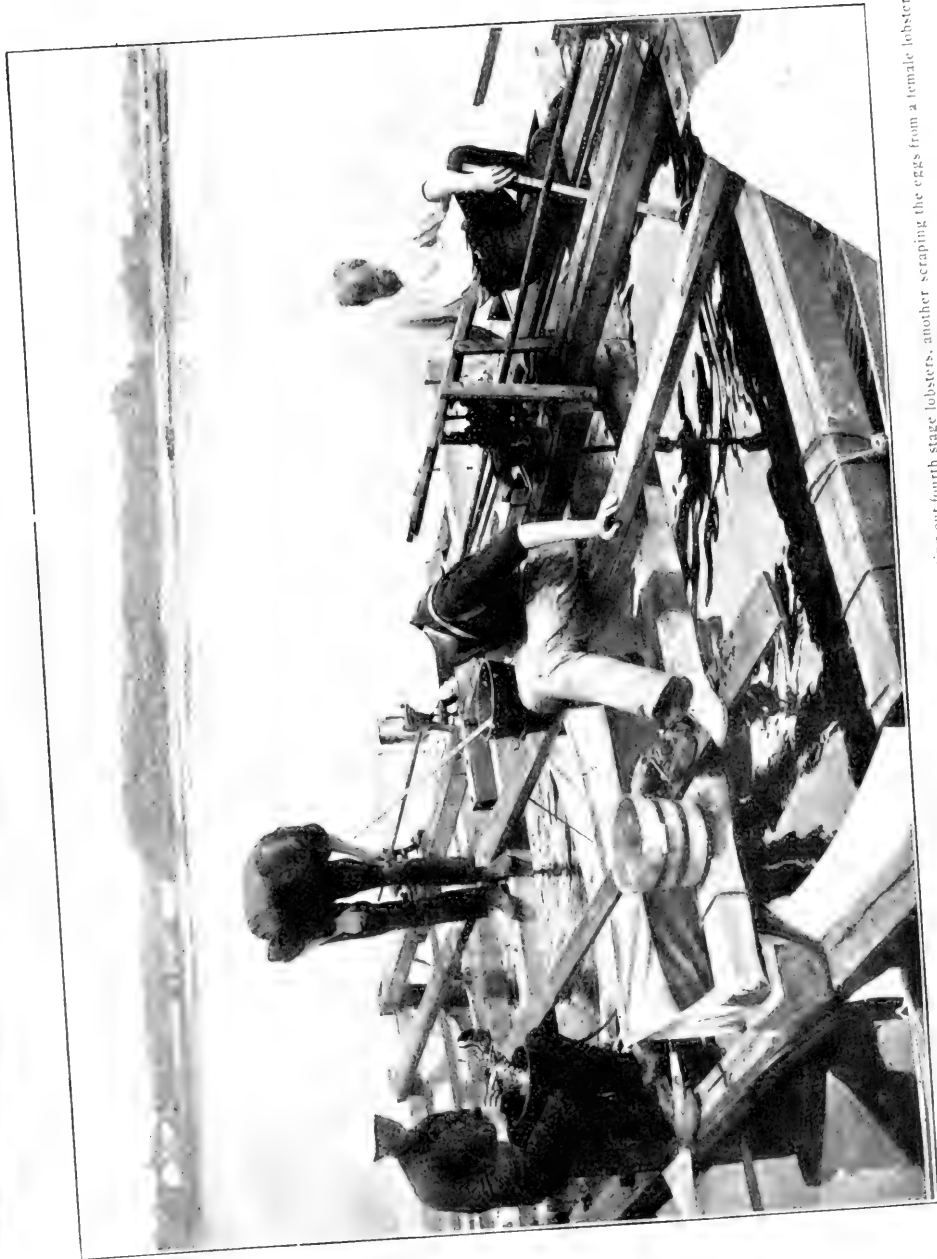


PLATE IV.—Shows the method of "putting down" one of the twelve-foot lobster bags.

feet square and four feet deep. Each bag has in it a two-bladed propeller, or "paddle," revolving about ten times per minute, which creates an upward whirling current of water strong enough to keep the fry and particles of food suspended. The vertical shaft of each propeller is geared to one of three longitudinal horizontal shafts: these, in turn, to a transverse shaft which is belted to a two-and-one-half horse power gasoline engine. Each paddle shaft can be thrown out of gear by a lever. The transverse shafts of the somewhat movable floats are coupled to the one running across the house boat by a universal joint and sliding shaft. The latter is a square shaft in two pieces sliding in a sleeve which is cast in two pieces for the sake of economy in manufacture. A drive of 75 feet of shafting is required to reach the farthest paddles, and the bed for the shafts is not, by any means, an example of modern "mill construction." Indeed the floats are constantly bending with the motion of the water, and also warp more or less. The shafts also are almost continually bending, but as they are comparatively light no trouble results from the lack of rigid construction and the transmission is very satisfactory.

The improvements in this phase of lobster culture, namely, that of hatching and rearing to the fourth stage, will, it seems to us, be mainly in the construction of the bags, the feeding of the lobsters, and the prevention of parasitic growth. The latter difficulty, however, is not so serious at Wickford as it was at Wood's Holl. Undoubtedly the percentage of yield can be raised by experimentation along these lines.

It is interesting to trace the actual results of these improvements in apparatus. In the year 1899 in the floating scrim bags at Wood's Holl Doctor Bumpus succeeding in rearing about one hundred lobsterlings to the fourth stage. This was one hundred more than had been reared to that stage previously by any method. In 1900 at Wickford 3,425 fry were reared to the lobsterling stage and 748 of these came from one experiment which was stirred with an oar night and day. This latter number was more than had been reared previously by the combined efforts at all other localities. With the mechanical device of 1901 the number reached 8,974; in 1902, 27,300; in 1903, 13,500; in 1904, 50,597. The total number for the pres-



One may be observed counting out fourth stage lobsters, another scraping the eggs from a female lobster in the hatching bags.

ent season, 1905, is 192,000; the entire total for all previous years is 103,796. The largest number reported from any other station is 3,750, reared by an apparatus of the same principle at Wood's Holl in 1902.

In ascertaining the number of lobsters reared to this stage the methods of estimating are not trusted, but the lobsters are counted one by one as they are dipped out of the water with a tea strainer fastened to the end of a stick.

It is obvious, of course, that the output of "lobsterlings" might depend upon the number of newly hatched fry available and on the extent of the apparatus. Taking these things into consideration the comparison is still more favorable to our station, for in most, if not all, other stations the supply of fry has been greater and the per cent of lobsters living through the three moults smaller.

The exact proportions of newly hatched young reared to the fourth stage can be ascertained accurately only by counting the number at the beginning and at the end of the experiment. The time required for counting is so considerable that only in few cases were the fry counted at the beginning of the experiments.

On June 7 and 8, 1905, 20,000 in the first stage were counted and placed in one bag. The "fours" began to appear in ten days and all that lived reached this stage before the end of the twelfth day. 9,635 lobsters in the fourth stage were counted from this twelfth bag; a yield of 48.1 per cent.

On June 28 and 29, 20,000 young fry, of the first stage, were counted into one bag. From this lot 8,178 in the fourth stage were counted; a yield of 40.8 per cent.

These two experiments illustrate very well the general results of the season's work, as there was no extraordinary care given them nor were they conducted under especially favorable conditions.

The proportionate yield is large as compared with that of other stations. The largest of these reported heretofore is 6.6 per cent.: Appelöf, of Norway, and 21 per cent. at Wood's Holl, where the Wickford apparatus was used. The 6.6 per cent was obtained as an experiment beginning with 1,500 fry in the

second stage. The 21 per cent was obtained in an experiment beginning with 3,000 (estimated) fry in the first stage.

A higher percentage has been obtained at Wickford with a smaller number; for example, 50 per cent. fourth stage lobsters were obtained from a lot of 1,000 in 1901, but in order to make the results practical they must be conducted on a larger scale.

The question of course arises are the efforts of the Rhode Island Commissioners in thus rearing and planting lobster fry apparent in an increase of lobsters in the waters of the state? The time has hardly come to answer this question. From our experiments it has been determined that it requires some five or six years for a lobster to attain a size of nine inches or more and the planting of fry has not been carried on as yet on a large scale for that length of time. However, in the vicinities where these lobsters were liberated, the lobster fishermen report that, for the last two winters young lobsters of about eight inches in length were abundant along the shore many of them being dug up by the clam diggers and by ourselves, and it is said that small lobsters have not been seen in abundance in these localities for twenty years. The lobster fry planted by this Commission should be about as large as these young lobsters by this time, and it seems probable that this large supply of young lobsters is the result of the efforts of the Commission. Again this past spring the lobster fishermen report a surprising abundance of young lobsters too small to be held in their pots. When the pots were pulled the little fellows scampered out between the slats. It certainly looks as though in a few years more, with continued efforts on the part of the Commission, the lobster industry of the state, now so dangerously near total extinction, might be rescued.

We feel that the efforts of the Rhode Island Commission have met with success. There are many difficulties to be overcome, and many chances for improvement. Among the subjects to be further investigated is that of the proper food for the fry. We at present feed finely chopped clams. At Wood's Holl finely chopped fish was used. Neither one is a perfect food. With improvement in the food probably a larger percentage could be raised to the fourth stage and in less time.

The presence of a growth of diatoms and other organisms on the fry is another serious difficulty. The amount of this growth varies with different seasons. It can be partially overcome by proper shading of the bags. A warm temperature, clean water, proper aeration and circulation of water, proper food will so hasten development that trouble from this parasite growth will be largely eliminated.

There are many other problems connected with the latter stages of the lobster which are of great importance, both economic and scientific. The Rhode Island Commission has undertaken the solution of some of these. The habits and requirements of the young lobsters which have passed through the earlier stages, the rate of growth and age of lobsters up to the marketable size, the migration of adult lobsters along the shores and to and from waters of adjoining states, their migrations to and from deep water, the rate of growth of large lobsters, the extreme age to which lobsters may live and breed, the rate of moulting of the old and young lobsters, questions connected with the loss of claws or appendages and the relation of the growth of new claws or appendages to growth and moulting.

But these are problems for the future. It is sufficient for us at present that we have worked out a method of lobster rearing which enables us to hatch and rear lobsters on a large scale, is comparatively cheap, at least cheap enough to be practical, is capable of indefinite expansion and which will enable us each summer to rear a large number of lobsters to a stage where they will, when liberated grow into large lobsters in sufficient numbers to restock the waters of the state.

DISCUSSION.

During the reading of the paper by Dr. Mead, Dr. Gorham said:

Forty-eight per cent. of survival of lobster fry is about all that can be expected.

About half the young lobsters consume each other. With better food, however, the percentage of survival may be increased.

In the side and bottom of the box are wire screens to allow

circulation. The crates circulate in the water until the eggs are all hatched. The hatching is done direct in the water, the eggs are removed and the lobsters are fed at proper intervals day and night. In anywhere from eight to twenty-one days, varying with the temperature of the water principally, these fry pass through their successive changes, finally changing their habits when they reach the fourth and fifth stage, and are then ready to be liberated.

Dr. Smith: Do you consider it possible, with the apparatus now employed, to rear the fourth state, say 1,000,000 lobsterlings, without undergoing an expense that would be prohibitive? It seems to me that is the crucial question, as applied to this method which has been so successfully evolved by the Rhode Island Fish Commission.

Dr. Gorham: Without any great increase in expense, using the same horse power engine, simply by extending floats, and increasing the number of bags, we could extend the plant so that without very much difficulty we could rear in a season a million fry to the fourth stage.

Mr. Atkins: Would it not take an extra lot of men to operate those bags?

Dr. Gorham: I think the entire number could be easily cared for by the same number of men.

Mr. Titcomb: What do you estimate the cost of the present plant to be?

Dr. Gorham: The laboratory of the Rhode Island Fish Commission spends about \$3,500 in a year in its investigations of lobsters, clams and other shell fish. The lobster season extends from the middle of May till the middle of July, or the latter part of July, and I should say that certainly less than half of the appropriation was devoted to the lobster work.

Q. Can you give me an estimate of the cost of the plant itself, aside from operating expenses?

A. I could not say offhand.

President: The expenses, including all the machinery and

everything connected with it, labor, food and salary of some of the men that are employed, are about \$3,500 a year, and it has been divided up so that in any one year we have not had any great expense, nothing to exceed \$3,500, probably about \$3,000. In the first place we got the Marine Laboratory that cost us \$1,000, and then as was necessary and these experiments called for it, we added gradually. To start right with a plant to hold a million lobsters, I do not believe it would cost over \$5,000 for the plant, machinery and everything. You do not need a large house-boat. Ours only cost \$1,000.

You must remember that all our work is not devoted to this one subject, and all this expense which is charged to the laboratory work is divided. We spend a great deal of time on the clam business. We have developed an industry there in which there is any amount of money commercially, if people will take it up. We have demonstrated practically that sea farming pays better than land farming. We have demonstrated beyond question that seed clams placed in the shore and protected, in fourteen months will become edible. When they become edible they sell readily at wholesale at \$1.25 per bushel. We can raise from 700 to 1,500 bushels to the acre. That is quite a farm.

Then we have taken up the artificial propagation of fish to a limited extent there. We thoroughly investigated the Star fish in all its phases. We have been through all these things and worked them down to a final conclusion. The only thing we have not reached is about some diseases of fish; and I do not think anybody is going to reach that right away.

We have arrived at this point, that there is a great deal of interest in our state in the work we are doing. In our largest fair we made an exhibit last year called "Sea Farming" which attracted the attention of the public. This year they have asked us to make another, and we shall elaborate on the former exhibit.

We are doing a labor of love. We do not get anything for it. Even Dr. Mead gets nothing for his services; but we think we are going to do some good. New Zealand has appropriated £7,500 for fish farming; and has sent over for all of our plans and apparatus, and are going into it with that amount appropriated already. We have a good deal of correspondence from

all over. Men have been there from Germany, Japan, and all over, to visit this work, and it has attracted much attention; and we feel very proud of it. We do not want to blow our own horn, but hope you will get interested in this matter, especially those of you who are located on the sea shore.

I do not think the United States government could take hold of anything that would add more to the industries of this country than the work of growing lobsters. The lobsters are going, not growing.

One of the difficulties in a large plant would be to get the eggs of the lobster. We have an understanding with all the lobster fishermen, that if they will hold their egg lobsters we will buy them and pay them more than the market price, and then return the lobster to the waters. In Maine you can get any quantity of them, but on our coast it is difficult to get female lobsters.

Mr. Titcomb: The work of the Rhode Island Commission is most practical. That is a kind of scientific work that the world admires, and the practical results are admirable. I am asking these questions as a business proposition. As I understand it now, the statement that the plant cost originally \$1,000, does not mean that the actual lobster hatching plant cost that much.

President: Oh, no, not by any means. Of course, to get this machinery was quite a little item, and required quite a little study on the part of Dr. Mead; and he had to work the whole plan out. Of course, it is not perfect yet by any means. I do not think he had a machinist there at all. He would think out an idea and go to some machine shop and have it executed and put it in there and try it. All experimental work, as you know, was a matter of delay, worry and effort, building up one thing on another—it is at that stage now. Dr. Gorham has been there only a short time, but he has done remarkably well and we think a great deal of him. The whole credit of this enterprise is really due to Dr. Bumpus. When he was in the employ of the United States Government he was also with our commission. He took hold of this matter and had an idea that the problem could be solved; and you know Dr. Bumpus goes ahead and

don't give up. We have only followed along on the lines on which he started us.

Mr. Titcomb: I would like to ask Dr. Gorham what percentage of fry he thinks he gets by allowing the eggs to hatch naturally on the lobster, as compared with the percentage which he would hatch by the artificial method?

Dr. Gorham: It is a little dangerous to attempt to estimate the proportion that can be hatched by the artificial method. We have tried a number of times to get an accurate estimate of the number of eggs hatched when they have been removed from the lobster. As near as I can figure it, 71 per cent. would cover the actual number hatched by that method.

We are sure, by experimenting, that the number of eggs hatched from the eggs while still on the lobster, provided the lobsters have been properly treated and not kept on ice till the eggs are killed, is something like 98 per cent. We can then rear approximately 50 per cent. of these fry to the fourth stage, where we are sure that a large number of them can care for themselves and grow into large lobsters. There can be no doubt of that. We have made a number of experiments in which we have counted the actual number of fry hatched from the eggs, and the actual number of fourth stage fry reared from those that have been hatched and with the apparatus as it stands at present, we know we can rear every time about 50 per cent. of the fry to the fourth stage, and we also know that with the same plant increased for the accommodation of a larger number of fry, without increasing the size of the house-boat itself, and without increasing the size of the engine, we can rear ten times that number of fry, without any doubt. And it seems to me that when we know the great possibility of these fourth stage fry living to reach the adult stage, and the great advantage that we have in planting fry of that age over planting fry that have been hatched directly from the eggs, there can be no question but what any efforts we can make to increase the number of these fourth stag fry that are planted, would be crowned with considerable success, and would certainly increase the number of lobsters in the waters where these fry are planted.

Mr. Titcomb: What would you do with 10,000 to 15,000

egg lobsters? Would you try to have the eggs hatch on them naturally?

Dr. Gorham: You mean in the season? We impound our lobsters through the winter so that we can have that condition during the spawning season. By shipping eggs on lobsters we rear a larger number than by stripping the eggs.

Q. Do you think it possible to do it on that stupendous scale?

A. Yes. We keep lobsters impounded until the eggs are near the hatching point, and so we would have a comparatively small proportion in number of lobsters in our crates at a given time. Those lobsters are kept in crates about forty-eight hours, when all the eggs will be found to have hatched into fry.

Mr. Titcomb: We keep these lobsters in pounds. When lobsters are impounded the eggs almost all hatch simultaneously. That is due to this large collection of lobsters being at an even temperature instead of being collected from various parts of the coast where they are in different temperatures. We find that the impounded stock gives better eggs than stock collected from fishermen along the coast at different places. But they all come out almost simultaneously. If you obtain the young lobsters in that way, would you undertake to rear to the fourth stage from 50,000,000 to 100,000,000 fry?

Dr. Gorham: We might have to vary our methods, provided a large number of eggs were at the hatching point at the same time. It might be better in that case to hatch the lobsters in a pound without rotating mechanism, and then collect the fry as they hatch, and place them in rearing bags. Some such scheme could readily be devised to take care of large numbers of eggs coming to the hatching point simultaneously. At the Wideford station we would have increased the output considerably if we had more egg-bearing lobsters. The number of egg bearing lobsters is small compared with the large number of fry which we carried to the fourth stage.

Q. Do you use a closed jar?

A. No. We have experimented with stripping lobsters and putting the eggs in the bags, but we find it better to hatch the eggs while still on the female.

Mr. Titcomb: We had some eggs hatched in open-top jars at Woods Hole, and experimented with them in two other stations, in comparison with the closed-top jar. Most of the superintendents consider the jars equally good, but object to the square aquarium into which the open jar empties, because of the dead space in the aquarium where the lobster fry, shells, etc., collect, and there the fry gets smothered or devoured.

Dr. Gorham: If the open-top McDonald jars could open directly into one of our bags with a rotating fan, it would solve the difficulty.

Mr. Titcomb: We have learned one other thing this last winter. Perhaps you have tried it. We have carried in live cars at the Woods Hole station, lobsters throughout the winter, which were collected in the fall of the year. That is the first time that has ever been attempted with us.

Dr. Gorham: We have reared lobsters from the egg until they were four and five years old, keeping each lobster in a separate compartment, sinking cars to the bottom of the channel, where they are free from freezing. Those were individual lobsters on which we were making observations for growth, moulting, etc. We have not kept lobsters throughout the winter on a large scale.

Mr. Titcomb: These were cared for, about 200 lobsters to a car.

Dr. Gorham: They fight so that I think it is better to keep them separate.

Mr. Titcomb: We lost some lobsters. Mr. Locke stated that he thought some had been stolen, as there was no remnant of lobster found where they had disappeared.

It seems to me this work is getting into a state where we all ought to take hold of it. The bureau ought to take hold of it and follow on, starting from where you now have it. But it

will be a tremendous proposition when you consider rearing to the fourth stage from 70,000,000 to 200,000,000 lobsters. We shall probably take 175,000,000 to 200,000,000 eggs on the Maine coast.

President: Let us have some of them.

Mr. Titcomb: The people on the Maine coast would rather have their lobsters killed than give them away.

President: I understand that what lobsters you take, the fry has to be returned to their waters.

Mr. Titcomb: That is the understanding and the law. Undoubtedly there are 200,000,000 or 300,000,000 eggs going to waste there every season, but the fishermen themselves will sell the female lobsters, stripping the eggs from them first, rather than sell them to us for the same price.

Dr. Gorham: In rearing lobsters to the fourth stage, the question of temperature is very important. In Maine, where the temperature is low, it takes twenty-one days to carry them through to the fourth stage, while at Wideford in July, it takes less than nine days to carry them through to the same stage. That would be an argument in favor of establishing rearing stations in the warmer waters. The temperature is an extremely important factor in determining the rapidity with which the fry go through their various moults.

Mr. E. D. Roberts: You have spoken about your fourth moult lobsters. I will present you with a fifth.

(Laughter.)

(Mr. Roberts referred to a little lobster pin which he was distributing.)

NOTES ON SMALL MOUTH BASS CULTURE AT THE NORTHVILLE, MICHIGAN, STATION.

BY FRANK N. CLARK.

In the Bulletin of the Michigan Fish Commission, No. 7, on "The Breeding Habits, Development, and Propagation of the Black Bass," by Jacob Reighard, a work prepared largely on observations made, and information collected in the spring of 1903, at the State Hatchery at Mill Creek, Professor Reighard says: "For some years efforts have been made, chiefly by the United States Fish Commission, now Bureau of Fisheries, Department of Commerce and Labor, and by the Michigan Fish Commission, to artificially propagate the black bass." "These efforts," he states, "have met with many difficulties."

This, as will be noted, was said two years ago, and so far as my observations go, the difficulties still arise, and must be overcome by the practical bass breeder. It is, I presume, conceded that with the large mouth bass, most of the problems in connection with their culture have been surmounted, and a considerable degree of success achieved. With the small mouth bass, however, so far as my investigations go, together with information from reading the works of others, it seems that there is much to be learned before arriving at a point of reasonable success, or where we can supply one-half the demand.

It is true that Mr. Beeman tells us, in his report for the years 1903-1904, to the Connecticut State Commissioners, page 28, that he estimated 400,000 small mouth bass fry were produced from a stock of twenty-five parent fish put in the ponds the fall before. It is probable that Mr. Beeman would revise his figures somewhat at the present time, or at least he would if he had the same kind of small mouth bass we have at the Northville Station.

The following are the breeding ponds in use this spring, with the area of each and the number of male and female bass placed therein:

	Area Acres.	Males.	Females.	Total.
Pond L.....	0.64	25	30	55
Pond O.....	0.60	30	34	64
Pond P.....	0.70	35	40	75
Total		90	104	194

On account of the backward season, the drawing down of the ponds in which the adult bass were held was delayed until later than desirable, being May 6, 7, and 8. It is thought that handling the fish so near the mating period had the effect of discouraging the spawning of many. Moving the parent bass from the ponds in which they are wintered, and transferring to other breeding or nesting ponds, is not thought desirable. Just previous to the spawning season each pond was provided with as many Lydell nests as the area would permit. The arrangement of the nests being very similar in all, only one pond will be noted.

Pond P, which was considered one of the most desirable as to available spawning area, was arranged with twenty-four artificial nests, as shown in the accompanying diagram, and represented by "X," while "O" designates the natural nests. The latter in the center of the pond were in from four to six feet of water, considerably deeper than the artificial, and furthermore, the natural nest in the center of the group produced the largest number of fry, yet was in the maximum depth of water above mentioned. Of the twenty-four artificial nests placed in this pond nineteen were cleaned by the bass and spawned on, and fifteen of this latter number hatched fry, fourteen of which produced fry ready for shipment.

It will be noted by the diagram that there were eight natural nests prepared, seven of which were spawned on and produced fry. Of the seven, two died before the fry were more than twenty-four hours old, making five the final result. Thus it will be noted that of the total number of nests in the pond on which eggs were deposited, namely twenty-six, nineteen furnished fry for distribution or holding for further development. These were estimated at 85,000 in number. There were taken out of this pond 35,000 as fry and distributed to applicants.

20,000 were placed in Pond M for rearing, and an estimated number of 30,000 left in the pond. Since then it has been drawn down, and 10,500 fingerlings, actual count, taken out. These fish were from one to two and one-half inches long, samples of which are before you.

The following extracts are made from the daily record of observations more particularly affecting the pond we are endeavoring to follow:

May 5, 1905.

Twenty-four artificial nests placed in Pond P.

May 6, 1905.

Forty females and thirty-five males put in pond.

May 10, 1905.

Today's examination showed ten artificial nests cleaned up nearly ready for eggs; temperature of water 59° F.

May 11, 1905.

Water dropped to 52°, caused by cold hard rain. Spring water turned on, creek water being very roily.

May 13, 1905.

Creek water warmed to 62°; almost clear. Valves, therefore, changed, and it was again turned into pond, being considerably warmer than the spring water. Male bass cleaning up more nests.

May 15, 1905.

Water very clear; temperature 64°. Examined nests and found that nearly all had eggs on. Several natural nests cleaned up.

May 17, 1905.

Examined nests in Ponds L, O, and P, and as a result forty-five with eggs on were found. Some fungus appears on older nests. Temperature of water 63°.

May 18, 1905.

Temperature dropped to 59°; cold rain; not severe enough to roil water to any extent.

May 21, 1905.

A few fish hatched; first of the season. Temperature of water 62°.

May 26, 1905.

Eggs all hatched, thus making the spawning and hatching period eleven days, in a mean temperature of 63° Fahr.

The nests were nearly all screened on the sixth day after hatching, and on the seventh and eighth days the fry had risen to the surface, and the distribution was commenced. Temperature of the water at this time was 69°. Very few were put out as fry, and this in not to exceed a period of five days, for thereafter the fry requiring food it is necessary to discontinue the distribution. At this point it might be well to say that the distribution of small mouth bass as fry is not considered advisable where they are to be in transit to exceed ten or twelve hours.

The young bass begin to change in color from the black to a mottled green in from ten to twelve days after rising, in a temperature of about 70°. This latter was registered by the thermometer during June and the fore part of July, with an occasional day when it reached 80°.

In summing up the observations and experiments in connection with Pond P, the question naturally arises as to why certain artificial nests were left, and natural nests, in deeper water, cleaned up and used instead. Also why did the eggs die on four of the artificial nests, and again why did the fish die on two natural nests and on one of the artificial. In my judgment all of these questions are to be answered by saying the fish were handled too near the time of spawning. No fault whatever, could be found with the fish at the time of moving from the ponds in which they had been through the winter. They were in excellent condition. In fact, comment was made by the entire force at the time as to the plumpness of the fish, both male and female.

From the experience the past two seasons, it has been fairly well demonstrated that from twenty-five to thirty artificial nests, arranged in favorable locations, would be most productive of results in an area of water equal to Pond P, or seven-tenths of an acre. It has also been decided that the previous fall the ponds should be thoroughly cleaned, and nothing left to be done the following spring except to place the nests. At the time of cleaning in the fall, the ponds should be drained perfectly dry,

if possible, so that any scattering yearlings that may have escaped the seine the previous spring may be removed. This is essential if success is to be had with the succeeding hatch, for even a few well advanced yearling fish in the pond would, the following season, destroy large numbers of fry and fingerling fish.

With reference to the guarding of the nest by the male, the observations at Northville could hardly substantiate what has been said of this feature of the small mouth bass work by others to the effect that the male guards the young bass until they are about one inch in length. The writer's experience has proved that soon after they begin to take food, from eight to ten days old, the young bass begin to distribute themselves around the edge of the pond, the adult male fish giving them practically no attention. They are fairly well scattered about the edge of the pond, if it is not too large, long before they are an inch in length. Furthermore, I see no reason why they should be guarded, and kept huddled up, as they are in quest of food, and the more they scatter, the more and better feeding grounds are to be found. It is also certain that fry transferred from the screened nests to a rearing pond, away from the care of the adults, do equally as well as those left in the pond with the parent fish. In this connection, another point to be brought out is that practically none of the young bass are eaten by the parent fish of either sex, until they are from one and one-half to two and one-half inches long.

In no paper or publication has been discovered any statement as to the exact period of incubation, in a given temperature of water, of the eggs of the small mouth black bass. It may, therefore, be of interest to cite a specific case observed at the Northville Station the season just passed, that gives this data with considerable more exactness. In order to arrive at something like a definite conclusion, an artificial nest selected at random at the beginning of operations, was marked, and carefully studied thereafter. On May 16th, between 10:00 A. M. and 3:00 P. M., eggs were spawned on this particular nest. It was examined very closely from day to day until May 21st, on which day at 11:00 A. M. there was no indication of the fish leaving the shell, but at 3:00 P. M. all were hatched, thus deter-

mining the time of incubation to be five days at an average temperature of 63 3-5° Fahr.

With regard to the volume of water supplied to each pond, it may be anywhere from 200 down to ten gallons per minute, which latter is ample for the average pond to offset evaporation and seepage. In fact, it is much better to have a light flow, as the temperature will be higher, and it is considered that natural food will increase faster in the warmer water. Also at the spawning time it is absolutely necessary that as small a quantity as possible be used, that the temperature may be kept above the danger point on cold days of 54°.

From conditions recently noted, one can conservatively say that a pond of seven-tenths of an acre, should, with the proper proportion devoted to spawning area, produce from 75,000 to 100,000 fry on the average. This same area, with one-third to one-half that number of fry retained in the pond, should produce from 10,000 to 15,000 fingerlings, with also possibly from 1,000 to 3,000 to turn out in the fall at the final cleanup.

In order to obtain the best results at a small mouth bass breeding station, the ponds should not be too large or too deep, but have plenty of them. It is preferable that they be from one-half to not over three-quarters of an acre in area, and a maximum depth of six feet in about one-quarter of the pond is best. It is thought that by removing one-half of the fry from a spawning pond used to its full capacity, practically as good results will be obtained with the number of fingerlings turned out, as though all the fry had been left, unless at some time in the future, greater quantities of food may be grown in a limited area.

DISCUSSION.

During the reading of his paper Mr. Clark said:

I call these nests in my paper, the Lydell nest, because he invented them, and I want to give him the credit.

We have our pond so arranged that whenever there is a "roil," which of course is considered fatal to the eggs on the nest, we can, by closing one valve and opening another, change from creek to spring water. This is very desirable in a bass pond, when you have the roil; and it forms the basis of a very

interesting and easy experiment. It is said by both Mr. Bower and Mr. Lydell, to be a very good feature of the Northville plant.

Mr. North: Is your object in using the creek water and spring water in combination, to keep the water warmer?

Mr. Clark: There is no combination.

Q. You use spring water at one time and creek water at others?

A. Yes, sir.

Q. What is the object of that?

A. We prefer the creek water, but we change in case of roil in the creek water, which we want to avoid. Of course, where you have not got any spring water, the creek water can be turned off and no water run in the pond at all, so long as you can keep the water high enough.

Mr. North: In our hatchery at London we use spring water entirely.

Mr. Clark: That is not so good for the young fish, because you have not got the food there.

Mr. Whish: What water plants do you have in your pond?

A. We have several, but I like the chara moss the best. It produces the most food. Interest might be aroused in describing how I spent an hour one Sunday morning lying down to watch the young bass apparently eating the vegetation. Of course they were not, but instead were after the little insects on the vegetation. In no place did I see them attack any plants whatever except the chara moss. I watched particularly to see if they would not take hold of any other vegetation, but they kept going around naturally and I did not see them touch anything else.

Dr. Evermann: You said it was observed that the parent fish did not feed practically at all upon the young until they were an inch and a half or two inches and a half long?

A. That is my judgment.

Q. What was your observation as to feeding on the young after that age?

A. None at all.

Q. Have you observed the young fish feeding on each other at all?

A. I never saw them do it, but I have no doubt of it.

(Mr. Clark produced bottles containing specimens of small-mouthed bass.)

Mr. Clark: You will notice in the largest specimen bottle where the fish are fifty-four days old, they measure three and one-quarter inches in length; and here are others of the same age which do not exceed one inch in length. These latter are starved fish and all were taken from the same pond.

Mr. Lydell: Did you not have a later spawning with that sized fish?

Mr. Clark: Possibly, but they were all put in that pond the very same day from the very same nest.

Dr. Evermann: Fed in the same way?

A. Yes, natural food.

Q. Are the sizes typical sizes?

A. Yes.

Mr. Lydell: I understood those were left in the ponds with the old fish?

A. No, they were not.

In this connection I wish to state that I thought I had solved the problem why these fish were starved. Possibly I have, but it is not as clear as I thought it was, last Friday night when I told Mr. Ward Bower in regard to it, and that I wanted the men to be sure to catch some of the fish for me on Saturday, some of the starved fish and some of the large fish that had escaped from Pond X into that pond. All the fish in that pond seemed to be large. He said, all right, and they were there the next morning, and after dinner they went to work. The fish

culturist asked me to go with him, and I did so. I wanted the large fish out of that pond, where there are any quantities of vegetation, and this chara moss more than any other pond, and I thought that was why they were so large. We caught those and got as many specimens as I wanted, and then I told them to go across to the stunted pond and they did so, and they made two or three little hauls; and, by the way, we have a large quantity of shiners in that pond. That I thought was why these fish were starved, because their food had been destroyed by these shiners.

Mr. Lydell: Are all of your fish in that particular pond of that size?

Mr. Clark: Just a minute. No. They went across to the pond and got two or three specimens; they moved up the shore and the first thing they knew they got hold of a big one, which was quite strange. We got a few more specimens and they then went around and obtained quite a number of the large fish. That, of course, upset my theory of the large fish in Pond Q, because here were some in this other pond also of large size. But I reasoned the problem out in this way, that the most of the fish in the pond were starved at an early period; the food that they should have had was eaten by the minnows, of which there was an enormous number. A number of them, however, succeeded in getting a start sufficient to permit of their feeding on the starved bass and very little minnows.

Mr. Lydell: Last year we held some fish in our screens too long before planting, and they never recovered. They were like Mr. Clark's fish, they were starved. I did not know but perhaps you had held your fish in your screen too long before transferring them to the rearing pond.

Mr. Clark: Here are some from other ponds transferred at the same time (showing specimens), and they are of good size. There was nothing of that kind. These fish were moved from the screens at the proper time.

Mr. Lydell: In shipping this year from Mill Creek our fish varied a great deal in size, but not as much as that.

Dr. Evermann: Was any examination made of the stomach contents of the big fish?

Mr. Clark: That is being done now, to see whether they have young bass in them. For fear you might think that some of these larger fish were small yearlings, I have brought along another specimen which is a small yearling, to show the difference.

(Specimen exhibited.)

Mr. Lydell: There is one part of your paper where you speak of your fish spawning in deep water, that is very interesting. I had some fish spawn in four feet of water, and the old bass stayed there and took care of those fry. They were scattered along the shore, a distance of probably thirty or forty feet, and the old bass patrolled his beat with great regularity. Although at Mill Creek we took a screen and put it over our nests, over half of those were still watched by the old fish swimming around outside of the screen.

Mr. Clark: Don't misunderstand what I say here. I do not mean that the male bass does not guard them, for he certainly does, but not until they are an inch long.

Mr. Lydell: I never saw him do that except where I made my earlier observations, there I have seen them guarding young bass when they were an inch and a quarter long. They would be scattered a long distance up the shore, but you could see the old bass would swim the length of the school and back and forth; so it was very positive that he was guarding that lot of fish. But I have not seen that in our ponds. In the absence of enemies probably he thinks it is not necessary.

Dr. Greene: Mr. North and I have been talking about this matter to-day. The superintendent of our farm at London has been using the apparatus devised by Mr. Lydell. They used it two seasons and used it this year; and in conjunction with that he has gotten up a device of his own. He goes along the bank, puts down gravel for a bed, then he also drives a stick down there in which he puts in partitions with slots, that he can slide partitions in; and if the bass use that bed and the eggs are laid

there; he then stalls that off; and we are trying that this year in connection with Mr. Lydell's apparatus. Mr. North and I have decided to have our superintendent keep a careful record of his work this year; and next year we want him to address the Society as to the comparative value of these two methods. We have at London, I think, the best springs and best ponds that I have seen or heard of anywhere. We have, within a distance of a quarter of a mile, a thirty-foot fall. That is one thing that is very desirable. Our waters, unfortunately for bass culture, is very cold spring water. The ponds are in tiers, starting from the west, and placed crosswise, parallel with the stream that formerly carried this water; and we cannot use the first pond or two on account of the cold water. We have no streams in the state where trout can be planted to advantage; but our third, fourth, fifth, sixth, seventh and eighth ponds, on down, where the water is warm, are very desirable for bass.

I have not had much experience, but have heard the superintendent talk about the question of the male guarding the spawn. He insists that they do that. He does not believe in cleaning his ponds too closely at the edge, but leaves all the vegetation and moss, because he regards them of advantage for the safety of the young fish. As soon as they take care of themselves they get into this moss and are free from their enemies, and protected there.

Mr. Clark: That examination of the specimens has just been completed. No bass or other fish were found in them. The specimens were taken out in the pond and immediately placed in formaline without being held any length of time. I still think, however, that the theory I expressed to the effect that they may have been feeding on the starved bass, or very small shiners, may be correct.

Mr. Meehan: In regard to the cannibalistic tendencies of young small mouth bass, I would say that last year, about the first of July, we placed 20,000 small mouth bass, probably an inch long, in a small pond. They were fed with ground fish, six times a day, and on the average it is estimated that they ate about three times their own weight of that food. On the first

of October we took the fish out and counted them, and there were 11,200.

Mr. Clark: In this connection I would like to state more fully and forcibly my idea on the rearing, or partial rearing of the bass. I think that a pond somewhere from three-quarters of an acre, to an acre in size, is better perhaps than a larger one, and can be handled easier; if you are going into bass operations on a large scale you should have a great many of these small ponds. The work of caring for them does not amount to anything. You have no food to prepare; no time is required in feeding; and one man will take care of 200 ponds just about as easily as five or ten. All he has to do is to screen them, and the feeding operation is going on all the time. Of course, with your artificial food you may be able to get out a better percentage, but we are looking for quantity as well as quality. I have been feeding fish for many years, but I am not prepared to say that the artificial food fish is as good as a natural food fish. Get back to nature, that is my plan; let them feed themselves and all the time. At Northville, instead of having the six ponds we have, there should be sixty, if we are going to do a great work.

Mr. Lydell: I had arranged this spring to carry on experiments in regard to feeding young bass, but unfortunately just as I had my ponds stocked and the fry ready to be introduced into these small ponds, we had a flood there that put us out of business, practically, as far as the small mouth bass were concerned. We only used two ponds there for breeding them this year, and from those two I had 58,000 that I had to ship as fry, because I did not have rearing pond room for them, although we used all our ponds for that purpose except one for large mouth bass.

In one of our ponds the chara weed was driven out by some other notorious brute of a weed that I do not know the name of, and there was no food there for the young bass. They did not seem to collect on the substitute weed as it did on the chara. I went around the shores of this pond and cleaned down probably five or six inches of dirt and spread white sand on that, and in a few weeks the chara came up through the sand and the other

weed disappeared. The nests that Mr. Clark spoke of in the beginning of his paper I lay no claim to whatever. In my article read at Put-in-Bay, you will find that I say something about the nests being used by Mr. Stranahan, and I give him credit for getting up that nest at that time. Although the idea was original with me, I found afterwards that he had used the nest long before I conceived the idea. So that I lay no claim to its invention.

I have some specimens of fish here to which I would like to call Mr. Clark's attention and ask him to compare them in age and size with his specimens, to classify them, and to state how many he would ship per can. They are mostly large mouth bass.

Mr. Clark: I do not think that the question of the numbers in the can has been brought up here.

Mr. Lydell: No, it has not, and this committee that we had appointed a few years ago has not decided yet what we shall call these fish.

Mr. Clark: The committee themselves do not seem to be decided.

Mr. Lydell: I am still shipping mine as fry, as baby-fingerlings and fingerlings, advanced fry, and yearlings, and two-year-olds, and several other sizes.

Mr. Atkins: I am still taking the pains to say just how many days old our fry are from the egg. I put that down in my report. I have not learned yet what the name fingerling means, so I never dared to use it.

Mr. Lydell: I find you cannot go according to ages for the the reason that we have, for instance, fish two months old varying in length from half an inch to two inches.

Mr. Seymour Bower: In regard to the standard of size, I could not agree with Mr. Clark's suggestion, calling them No. 1, up to thirty days, etc., but I like the idea of classifying them by number. But I would rate them according to length, 1 inch, No. 1; 2 inch, No. 2; 3 inch, No. 3, etc.

Mr. Clark: What would you call an inch and a half?

Mr. Bower: I would call them No. 1. Above an inch and a half or perhaps two inches I would call No. 2. You will come a good deal closer to understand what is meant if you classify them according to length rather than according to age. As you have shown, starved fish may be only one-tenth the size of others of exactly the same age; but in classifying them by length you cannot be more than half an inch out of the way, either way. That is my idea of the proper method to grade the fish, so we may know very closely what is meant every time, whereas you cannot if you grade them according to age.

Mr. Clark: As to the shipments per can, about which Mr. Lydell asked, he ships large mouth bass an inch long twenty days old, a thousand per can. This is about the same number we ship of the small mouth, except in cases of abnormal growth.

President: I think Mr. Titcomb made the suggestion that they did not care much at the Fish Bureau what designation was given fish; they sent out what they had. Will you please state your mode of classification at the bureau?

Mr. Titcomb: At the present time we have a plan of distribution showing fry, fingerlings and yearlings. Of course that is very broad. Fry are the young fish until they have been fed for a time and are perhaps an inch or an inch and a half long. Then they begin to be fingerlings, and continue to be fingerlings until they are perhaps three inches long, which depends on the kind of fish; and then in the fall of the year, as they get larger, they are called yearlings. Mr. Bower suggests numbering, as I suggested, only he has reference to the length of the fish, while I have reference to the age of the fish, and he has reference to one species of fish, while we want the committee to select it for all species. If we could, in our fish cultural parlance, not only designate them as No. 1 for one month old, but in connection with that give the size or weight per thousand, we would know what we are talking about. But for general tabular distribution, it seems to me that the numbering according to age would be suitable. In all this work I think we want to get into our tables and into our papers, not only a description

of the fish at a certain season of the year, or of a certain age, but the weight or some designation equivalent to that. Local conditions vary so at the different hatcheries of the country that fish of the same age may be an inch long in Maine, and three inches in Texas, respectively. Whatever kind of fish we are talking about, and when we are discussing questions of food and growth, I think we want to give all possible data, but in giving the tables to the public, it seems to me the general plan we have adopted in the bureau now, is as good as any, to call them fry, fingerlings, and yearlings. As far as the public are concerned they are satisfied.

Secretary: Do you mean to say that a bass the same age would be three inches long in Texas, and one inch in the north?

Mr. Titcomb: Yes, just about—not always, of course. There is a great variation of growth there, just as there is with us here, only it is much more marked.

Mr. North: Would it not be advisable to get up a combination name to indicate both age and length; for instance, No. 1 A thirty days old. No. 1 B sixty days old, and have the figure designate the length, and the letter the age. For instance, a fish an inch long and sixty days old may be No. 1 B.

DISCUSSION ON MR. TITCOMB'S REPORT ON POND CULTURE.

Mr. Clark: I have not anything in particular to say regarding Mr. Titcomb's paper on "Pond Culture," but I do think, now that we are working into the bass culture problem, that there ought to be more papers along similar lines; more especially in reference to the vegetation and on the question of growing natural food. I hope something will be brought out more particularly next year, perhaps not as much on how long a bass will grow, etc.; but we do want to know how, when, and what to put in our ponds to grow the proper vegetation and make the proper quantity of necessary natural food.

Dr. Evermann: I am rather inclined to believe that some of the difficulty is due to confusion of species. I have observed in aquariums, for instance, that *Myriophyllum*, *Ceratophyllum*, and a species of *Bidens* are often mistaken one for another.

The horsetail *Ceratophyllum* is objectionable because it is a floating plant and is not so desirable as the *Myriophyllum*, or the *Bidens beckii*. There are many species of the so-called water weed, and they differ a great deal in their values as forming a nidus for the growth of aquatic food, the different species of crustacea and various species of protozoa.

I would like to know upon just what is based the statement that the different species of chara are particularly valuable. At first blush it would seem that chara might not be so valuable a plant as a food producer as some of these other plants. It is coriaceous, lime-coated and hard; and is not a plant that would furnish food on which the young fish might feed in so large a degree as other plants.

Some little time ago some investigations were made by the Bureau of Fisheries at a certain lake in northern Indiana (Lake Maxinkuckee), and certain relations were discovered or thought to be discovered between the presence of young bass, large mouth and small mouth, and certain species of aquatic plants. The lake was two and three-quarters or three miles long and

one and a half or one and three-quarters wide, and quite regular in outline; and seining was carried on around that lake periodically for four months in the shallow water of the entire shore. It was seined with a fine-mesh Baird collecting seine during the first week of each month for four months, and the character of the vegetation over which the seine was hauled each time, was noted. The depth of the water, the temperature of the water, and different species of fishes, crawfishes and other animals that were caught, were examined; and the number of individuals of each kind, and the approximate sizes of the individuals of each kind, were determined; and particular attention was paid to the young of the large mouth and the small mouth, the rock bass, and the bluegill, for four species of food fishes found in that lake; and my recollection is that where the chara covered reaches of the shore, our efforts did not result in capture of as many small mouth bass as did those portions of the shore where we found Potamogeton, and certain other species of plants. Indeed, the Chara-covered part was regarded by those who carried on the work, as the barren portion of the lake. We would find there certain species of darters in considerable numbers, but neither the large mouth nor small mouth bass was found there in considerable numbers.

Now as to what species of plants are oxygenating and what are food-producing, I doubt if you could make any classification that would be of very much value on that basis. All aquatic chlorophyll-bearing plants are the same, except in degree, and as to what the plant will do in those regards depends on the time of the day and many other factors.

Mr. Titcomb: There was no confusion as to the different plants, so far as we went through them. They were all identified by the chief of the Bureau of Plant Industry, Mr. Covil and his assistants, before we made up our minds as to what we liked and what we did not, what had good features and what bad.

I will give you a list of what we considered the best at the fish ponds in Washington:

1. *Ceratophyllum demersum*.
2. *Cambomba Caroliniana*.
3. *Vallisneria spiralis*.

4. *Potamogeton crispus*.
5. *Potamogeton foliosus*.
6. *Philotria canadensis*.

But some of the sub-species are more valuable than others, and in talking the matter over with the plant physiologist it was agreed that it was not at all impossible to ascertain the comparative oxygenetic powers of the various aquatic plants. Perhaps it would be necessary to take a young man out of college as a scientific assistant or something of that sort, and let him work at it a year or possibly two, but it would be a valuable contribution to literature and to all those interested in these questions. We are going it blind. We have a lot of objectionable plants in our ponds. They are just as objectionable as the pig weed in our gardens. We want to know what they are; we do not want to introduce them where we start anew, or introduce them in the ponds of the anglers where they want food plants. All those questions are constantly coming up in the Bureau of Fisheries; and I might say that there are gentlemen here now who would like to know what to put in ponds full of stunted, starved bass.

Dr. Evermann: You have no species of chara in that list?

A. No.

Mr. Clark: I want to put in an emphatic protest against the criticism of the chara plant, for if it does not furnish food I do not know what our bass are feeding upon. We get excellent results where there is not a particle of vegetation in the pond excepting chara.

Mr. Meehan: This chara plant grows in bunches, does it not?

Mr. Clark: It forms one solid mass. We had some that was taken out this spring, and find that it decomposes to lime; that is, it is a lime plant. And the fresh water shrimp that the doctor discovered came off that chara plant. The smaller bass keep nipping, nipping on chara plant, and in this pond that I have mentioned there was other vegetation, yet they touched nothing else.

Mr. Lydell: I want to endorse Mr. Clark's remarks regard-

ing chara. I was out for the Fish Commission a couple of years and we got a great abundance of this plant, chara. And if that plant does not produce food I don't know what does. In one of our ponds this year where there was nothing but chara, you could see great clouds of food over this plant. You could take a pan and dip it up and could not see the bottom of the pan. What this food was I don't know. It is a new food that came there last year. I sent some to Ann Arbor to be identified, but never received a report.

Dr. Evermann: Have you made any comparison as to the value of different plants?

Mr. Lydell: Yes, sir. I found that Potomogeton drove chara out, and I could not raise 100 fish where before the chara went I could raise 1,000. I would like to find out what this new food is. It comes when the young fish are coming off the bed. When you look down on it you see a little three cornered black speck. Along the shores of the pond were thousands of little black shells about one-eighth of an inch in diameter, from which apparently these animals were hatched.

Mr. Seymour Bower: Two years ago this summer our board of Fish Commissioners engaged the services of Professor Reighard, the well-known zoologist. He was employed at the Mill Creek Station for three months to solve some problems in connection with bass culture. I have copies of his report with me and will be glad to give one to any who may desire it. My recollection is, his conclusion was that the chara was the best food producer of anything in the ponds.

Mr. Lydell: Professor Reighard said he never saw a pond so teeming with bug-life as ours with the chara in it.

Mr. Clark: Is it not probable that the vegetation which produces the animal food for our ponds at Northville, if transferred to other waters, say in Washington, Georgia, etc., might not do?

Dr. Evermann: I think so, decidedly.

Mr. Clark: The water and other conditions may produce this food at Northville, whereas the chara might be barren at

other points. We have got the plant that produces the food; we grow the bass with this vegetation, and until something is furnished which is better, it seems as though it is the plant we want to use.

Mr. Lydell: If there is any aquatic plant which we can substitute for the chara, and which has superior food producing qualities, we want it, but we would like to grow 5 or 6 or possibly 100 fish to every foot of water. So if you have any old weed that will produce the food, produce the weed. (Laughter.) If we have been working in the dark and produced thousands where we could produce millions of fish, we should like to be convinced of our mistake.

Dr. Evermann: The characters of the different species of chara depend on the ground. I have seen some places where there is very little lime in the soil or water, where none of the species of chara would do well. In this lake that I have in mind there is a wide belt of marl beginning out at a depth of perhaps $2\frac{1}{2}$ or 3 feet and extending on into the water 8 or 10 feet in depth. Well, on the outer half of the strip of marl, and further on to the shore, various species of chara grow in abundance, but in some other parts of the lake they do not. When, however, we came to the end of one of these chara patches, where there is a certain species of Potamogeton with the broader leaves, not the fine-leaved *Pectinatus*, we found the young bass; but we did not find them under the fine-leaved *Pectinatus* at all.

YELLOWSTONE PARK AS A NATIONAL FISHING RESORT.

(Illustrated by Lantern Slides.)

BY A. H. DINSMORE.

An outline of the lecture is as follows:

In 1872 Congress passed a bill setting apart a great volcanic plateau locked away in the heart of the Rocky Mountains, and comprising an area of more than 3,500 square miles, as a "public park and pleasure ground for benefit and enjoyment of the people." Because the greater part of its surface is drained by the Yellowstone River, this reservation has been called The Yellowstone National Park.

Yellowstone Park is most widely known as a region of strange natural phenomena and beautiful mountain and canyon scenery. It was for the preservation of these features alone that Congress was induced to exempt this vast region from settlement. But public measures, good or bad, seldom fail to reach in their ultimate results far beyond the conception of the assemblies which pass them. And so Yellowstone Park has become famous for many things of which its most enthusiastic advocate never dreamed. Thus, as the nucleus of a great timber reserve, its magnificent forests protect the sources of three of the most important rivers of the North American Continent,—the Missouri, the Columbia, and the Colorado of the west. This one feature, as a safeguard from flood and a potent factor in the great problem of irrigation, is alone worth to the American people many times the cost of its maintenance.

Then, as a great natural game reserve it is of inestimable worth for its preservation of the wild life of the west. Here all the animals indigenous to the Rocky Mountain region find an asylum where, unmolested by the hand of man, they may roam at will. And though elsewhere many species have already become rare or ceased entirely to exist, in the Park they are as abundant as ever and so tame as to be continually under the observation of the tourist.

All these features have been written about and talked about till they should be matters of general knowledge. Of one feature, however, of greatest interest to us as fish-culturists and fishermen, little is known, for little notice has been taken of the trout which now abound in its splendid lakes and streams.

But there is, perhaps, a reason for this ignorance in the fact that only a few years ago all its waters, except those of the Yellowstone basin, were entirely destitute of fish life of any value. The absence of trout from these streams and lakes has been accounted for on the assumption that all animal life was destroyed by the flow of volcanic matter which formed the plateau, while fish have been unable to ascend the streams from below on account of the great natural obstructions which they contain. But if these theories are accepted it becomes necessary to explain their presence in the Yellowstone, whose mighty cataract exceeds by far the falls of any other stream.

Scientists, some years ago, advanced the theory, which other writers have followed, that black-spotted trout, with which the entire Yellowstone system abounds, came here from the Pacific slope through Two Ocean Creek, a remarkable stream which, sub-dividing, sends part of its waters to the Atlantic and part to the Pacific. No account seems to be taken of the fact established by the geological survey, that Yellowstone Lake once stood 150 feet above its present level and then vented its waters to the Pacific through Outlet Creek and Hart River. As there were then no obstructions between the Yellowstone and the natural trout waters below, why may trout not have come here while this system of waters was still a part of the Pacific coast drainage?

However this may be, the fact remains that the Yellowstone had trout in great abundance when the region was first discovered, while they were entirely absent from all its other waters. The idea of creating from these barren lakes and streams a Great Natural Fishing Resort seems to have originated in 1889 with Capt. A. F. Boutelle, the then acting superintendent.

No stronger commentary on the success and value of fish-cultural work exists than that found in several pithy paragraphs from various reports of Capt. Boutelle and some of his successors. In his first report for 1889, Capt. Boutelle calls attention

to the original condition of things by saying: "I notice with surprise * * * * the barrenness of most of the waters of the Park. Beside the beautiful Shoshone and other smaller lakes there are hundreds of miles of as fine streams as any in existence without a fish of any kind." He at once brought the matter to the attention of Col. Marshal McDonald, then the U. S. Commissioner of Fish and Fisheries. Through his efforts 7,000 young fish were planted that year and 150,000 the year following. The work was remarkably successful from the first. For we read from the report of his successor, Capt. Anderson, only four years later: "During the season fish are taken in all the lakes and rivers in numbers almost passing belief. All streams heretofore stocked with trout now offered excellent fishing, probably no better exists anywhere."

Frequent reference in late reports of Major Pitcher, the present acting superintendent, to the fine fishing in these lakes and streams is sufficient proof of the lasting results of this work.

In stocking these waters, it has been the plan to place but one species in each river basin. Thus to the Gardiner and its tributaries has come the brook trout from the east. The Gibbon has received the rainbow from the Pacific coast, and the Firehole the Lochleven from Scotland. Below the junction of these last named rivers, in the Madison, both species mingle with the black-spotted trout, the Montana grayling and a native white fish. Other waters on the west side of the divide have been stocked with the lake trout and land-locked salmon, while the native black-spotted trout has been left practically undisturbed in their natural habitat, the Yellowstone.

The importance and value of this work will be understood if we remember that fully fifty miles of Park roadway, over which more than 10,000 tourists pass each year, lies along the course of these streams or skirts the lakes. But its greatest value is in its permanency. When other streams throughout the country become unsuited for trout life, as many already are, the beautiful lakes and streams of Yellowstone Park preserved in their primeval purity will carry to future generations a knowledge of these lords of the finny tribes.

Then, too, the region may in the future be the source from which shall come, from territory entirely under Government

control, many of the eggs of the various species of trout needed by the hatcheries scattered throughout the country. For several years past Yellowstone Lake has been utilized for the successful collection of black-spotted trout eggs. But with proper direction and oversight it should be an easy matter to extend the work to other species.

All other features of this great public park are being jealously guarded and fostered. Soldiers patrol its roadways, protecting its game from poachers; its formations from vandals, and its forests from the fires of the careless campers. Civilian scouts perform the same duties in the outlying districts. Its fish alone are left mainly to shift for themselves.

Here is a region belonging in a peculiar sense to all the people in which are trout waters of greater extent and value than those of many of the states, and yet its fishing interests are left entirely without skilled oversight. It has always seemed to the writer since he became familiar with these facts, that the National Bureau of Fisheries should have a representative in the Park that these interests may receive the same intelligent oversight and direction given such interests in the various states or the other interests of the Park. This seems the more important since its administration is in the hands of army officers, men of the highest ability and integrity but subject to frequent change, and in the very nature of things possessing no knowledge of fish-cultural matters. Hence there is constant danger that wrong plans may be made and the plan of keeping the various species separate ruined beyond remedy.

Under the directions of a superintendent of fisheries the fishing in many waters may be improved, fish may be planted in other waters still barren and the Park made in all truth the Great National Fishing Resort.

THE INTERNATIONAL CONGRESS OF FISHERIES AT VIENNA, 1905.

BY HUGH M. SMITH.

The Third International Fishery Congress convened at Vienna in June, 1905, under the patronage of the Austrian Fishery Society—a large, flourishing, and influential body which celebrated its twenty-fifth anniversary during the meeting of the congress.

The plan for holding international fishery congresses at regular intervals originated at Paris during the exposition of 1900, when the first congress was held. The second congress met at St. Petersburg two years ago. I had the privilege of attending both the Paris and Vienna congresses as the representative of the United States Government.

The president of the Vienna congress was Prof. Dr. Franz Steindachner, of Vienna, one of the foremost ichthyologists and the director of the admirable natural history museum of that city. The attendance was large, nearly 400 delegates being present; and the foremost fishery and fish-cultural authorities and workers in Europe were present. About twenty countries were represented, although there were some conspicuous absentees. Most of the European countries had official delegates, although the governments of such important fishing powers as Great Britain, France, and Norway had no representatives. From the far-distant British colonies of Australia and India special delegates were sent. The great western hemisphere made a poor showing; besides the United States, the only countries represented were our progressive sister republics, Argentina and Chili.

It is not necessary to refer in detail to the proceedings of the congress. Suffice it to say that the papers and discussions covered a very wide range of subjects; and it was the general opinion that the meeting was more successful and important than either of its predecessors.

Armed with authority from the Commissioner of Fisheries

and the Secretary of Commerce and Labor, I extended to the congress an invitation, on behalf of the United States Government, to hold its next meeting in the United States. The matter was first considered by the permanent committee on international congresses, of which I am a member, and was then referred to the full congress for final action. It was very gratifying to me that the congress voted unanimously to accept our invitation, out of sincere regard for and interest in the country which is foremost in fish culture and economic fishing. The time for the meeting was fixed for the latter part of September, 1908, and the place selected was very appropriately Washington, D. C.

At the proper time, I shall ask this society to take action with a view to its co-operation with the local committee of arrangements. I do not want the Society to commit itself too far in advance, but it seems to me that it will not only be proper but decidedly advantageous for the Society to meet in conjunction with the international congress—perhaps a day or two before—and I trust you will regard favorably the suggestion that you determine informally to hold your 1908 meeting in Washington.

It is incumbent on the United States to make the international meeting a great success; the reputation of our country is at stake. No people can contribute so much to secure the desired end as the members of this Society, individually and as a body; and I bespeak for this important project your cordial support.

THE STATUS OF THE CARP IN AMERICA.

BY LEON J. COLE.

(Read by Dr. Evermann.)

(Presented by permission of Hon. George M. Bowers, U. S. Commissioner of Fisheries.)

It is impossible to present in a paper of a length suitable to these meetings even a tolerably complete review of the carp question in this country. But since this is a topic of discussion which has not infrequently come up at previous meetings, and is one on which divers opinions have been expressed by members of the Society, a brief resume of the principal conclusions reached during an investigation of the subject by the writer, extending over a period of three or four years, may not be without interest. Manifestly very little of the data upon which these conclusions rest can be given, but it is expected that there will soon be published a full report on the work, which was undertaken by direction of the U. S. Bureau of Fisheries. The investigations were made principally on Lake Erie and Lake St. Clair and were prosecuted, for the most part, during the summer months of 1901, 1902 and 1903.

The first introduction of carp into America is a matter of more or less uncertainty. Although the name appears occasionally in earlier writings, apparently referring to some species of native fish, the first record bearing any stamp of authenticity is one by which Henry Robinson, Esq., of Newburgh, Orange County, New York, is credited with introducing these fish into the Hudson River in about 1831 or 1832. It has since been contended that the fish brought over by Mr. Robinson were not true carp; but in 1872 undoubted scale carp were successfully acclimatized by Mr. J. A. Poppe in Sonoma County, California, where they thrived well and multiplied with great rapidity. The first importation by the U. S. Fish Commission was made in the spring of 1877, and was followed by two or three other lots in succeeding years. Ponds were constructed for these fish in

Washington and Baltimore, and it is their progeny which were distributed and have populated nearly all of the available waters of the United States.

At first the carp met with great popular favor and requests for young fish came to the Fish Commission from all parts of the country far faster than they could be filled. Largely on account of ignorance of the proper methods, or negligence and want of proper care, pond culture did not, however, meet in most cases with success; and not only was almost all attempt at artificially raising the fish soon abandoned, but they came into general disfavor almost as rapidly. This was probably due to a variety of causes. In the first place the quality of the flesh did not compare favorably with many species of native fish, and in this respect did not fulfill expectations. To make carp palatable it is usually cooked in ways that were more or less unfamiliar or unknown to those who were trying the experiment in this country, and for this reason, too, it was not appreciated even for its true worth. But the adverse criticism became even stronger and more widely spread as, coincident with the rapid decrease which was noticed to be taking place in the numbers of many of our native fishes, the carp as rapidly multiplied and came to be exceedingly abundant in all the waters adapted to them. Not only were they held to be responsible for the decrease of other fisheries, but, owing to their propensity to stir up the mud and to root out aquatic plants, they were charged with destroying the vegetation in the marshes, and thus, secondarily, were said to be the cause of the rapid decline in the numbers of wild ducks and similar birds, whose feeding-grounds, it was claimed, were thus destroyed. The constant roiliness of the water, especially in reservoirs, due to the presence and operations of the carp, in many cases became a positive nuisance. But since nearly everyone is familiar with the strong dislike with which the carp has come to be regarded in all but perhaps two or three sections of this country, it is unnecessary to go further into detail. The investigations here reported were undertaken with the view to ascertain, in so far as was possible in a limited time, the true state of affairs—to find to what extent the carp was responsible for the changes taking place; and, on the other hand, to determine

its value as a food fish, and whether in this respect it was being utilized to the fullest possible extent.

I have elsewhere summed up the principal charges against the carp as follows: (1) that the carp thrashes about and stirs up the mud, so that the breeding-grounds of other fishes are spoiled; (2) that the carp roots up the vegetation, destroying the wild rice, etc., thus ruining good duck-shooting grounds; (3) that the carp eats the spawn of other fishes; (4) that the carp eats the young of other fishes; (5) that the carp is of no value as a food-fish; (6) that the carp is of no value as a game fish. To the first of the above charges should be added as a corollary that the stirring up of the mud of supply reservoirs often makes the water unfit for use.

In studying the relation of carp to other fishes special attention was paid to the small-mouthed black bass, which breeds abundantly in Lake St. Clair, and to the whitefish in Lake Erie. The former species builds its nests in numbers on the shoal, sandy bottoms at the St. Clair Flats, and as the carp is plentiful in the same localities, this seemed a favorable opportunity to make observations on the two species together. One breeding-ground in particular was watched continuously. But although the carp frequented and fed among the rushes of the shallow water near shore, they were never seen on the actual area occupied by the bass, and it could not be learned that they interfered with the bass in any manner whatever. Examination was also made of intestinal contents of carp taken in the same neighborhood, but in no case were the eggs of any kind of fish found among the material thus obtained. The principal food at this place was found to consist of certain aquatic plants, especially the stonewort (*chara*), and the larvæ of insects—mainly that of the May Fly, or "June Bug," as it is often popularly called.

At the western end of Lake Erie, where the whitefish come in the fall to spawn upon the reefs, especially in the neighborhood of Kelley's and the Bass Islands, there had been much complaint among the fishermen that the carp were also on the reefs in great numbers, and that at such times they destroyed large quantities of the whitefish spawn. In the fall of 1901 attention was turned to this phase of the question, and from Port Clinton, as a base, trips were made with the fishermen to the

fishing-grounds. In addition many carp which had been taken in the pound-nets with whitefish were examined at Port Clinton. The results of these investigations showed that comparatively few carp were on the spawning-grounds at this season of the year, while all that were taken were small fish, seldom exceeding two or three pounds in weight. Examinations were made of the stomach contents of carp taken in gill-nets directly on the reefs, and only in two cases was anything found that could be identified as eggs of the whitefish. Moreover, the water is cold at this season of the year, and under such conditions carp are usually inactive. It thus appears that although they do undoubtedly destroy some spawn the total damage done to the whitefish by the carp is probably small. It is rather generally conceded, too, that the supply of whitefish is being in large part maintained by the work of United States and state hatcheries, by which means the spawn is being removed from the danger of being devoured until the young fry have hatched.

There is little evidence to support the conclusion that carp eat the young of other fish. It has been known to happen on one or two occasions when the fish were confined in aquaria, but probably is not frequent under natural conditions. The carp, with its sucking mouth, devoid of teeth, is not adapted to predatory habits.

The charge that carp uproot and destroy much aquatic vegetation, and cause the waters in which they live to be in an almost constant state of roiliness, appears to rest upon a better foundation. But it is doubtful if the effect of this condition upon other fisheries and the wild fowl is quite as serious as has sometimes been supposed. One great objection is, however, that beautiful bodies of water are sometimes disfigured, and as has been said, the fish may cause great annoyance in the reservoirs used for storage of drinking water.

The other side of the question can best be examined under two heads: (1) The present commercial value of the carp and how its usefulness may be extended; and (2) what we may call the incidental value of the fish. The two great sources of carp for the eastern markets are the Illinois River and the suitable portions of the Great Lakes, namely, Lake Erie, Lake St. Clair, and the adjoining marshes. It was estimated by Townsend that

in 1899 the catch of carp in Lake Erie amounted to 3,633,697 pounds, worth \$51,456. In 1900, as nearly as I could determine, the catch was 4,598,090 pounds, with a valuation of \$68,971.35, wholesale. Indications are that in the succeeding years it was even greater, while the fisheries of the Illinois River appear to exceed considerably those of the Great Lakes. This is enough to give an idea of the extent to which carp are now being used. Some attempt has been made at smoking the larger fish, and other methods have also been used to preserve them, but those products appear never to have gained any considerable demand. The smoked fish, nevertheless, compares favorably with many other kinds now used for that purpose, and it would seem that persistence in this line should finally meet with success.

As illustrating the ways in which the carp may be said to be of use more or less incidentally, it may be noted that in Izaak Walton's time it was considered to be worthy of the angler's attention, and that even now in this country its capture furnishes amusement as well as acceptable food to many, especially those of the poorer classes. Furthermore, it is probably of value for its destruction of mosquito and other aquatic larvæ, and it has recently been shown to be an important factor in some sections of the country in keeping in check the parasite known as the liver fluke, which attacks sheep, often killing them in large numbers. Certain of the stages of this parasite are passed in the pond snail, which is eaten by the carp. It has also been found that the young carp, which can easily be raised in large quantities, make very good food for trout and bass.

The carp has sometimes been spoken of as "the poor man's fish," and such is essentially the position it would appear to be destined to occupy in the economy of our country. Those who are able to obtain better fish will undoubtedly continue to prefer them. But for feeding the great communities of foreigners and newly-made citizens in our large cities, any source of cheap wholesome food is of much importance, and, as has been shown, the use of carp for this purpose is increasing with each year. One often hears it stated that a bounty should be put upon these fish in order to attempt their extermination, or at least to keep them in check. It must be recognized that it is sheer nonsense to think of their extermination by any such means, and the

most effectual factor in holding them in check is the catching of them to supply a commercial demand. If, then, anything should be done, it should be to make the food value of the fish more widely known, and thus increase the market. At present there is no need to plan protection for the carp. They seem well able to care for themselves. But even now it is found profitable to capture them when they are plentiful in the spring, and to hold them over in retention ponds of one kind or another until the market prices are higher in the fall.

Finally, it may be said in conclusion, that whereas the carp undoubtedly does considerable damage in one way or another, it nevertheless is a valuable resource to the country, its value in this respect far outweighing the damage done. The whole situation may be summed up in the statement that the carp is here and we could not rid our waters of it, even were such a course desirable; therefore we should turn our efforts to utilizing the fish in all ways possible.

DISCUSSION.

Before reading the paper Dr. Evermann said:

I will say as a word of preface, that this paper which Mr. Leon J. Cole, of Cambridge, Massachusetts, presents, on "The Status of Carp in America," is a brief abstract of a much larger report which he made to the Commissioner of Fish and Fisheries, covering certain investigations which he carried on for a number of years.

CARP, AS SEEN BY A FRIEND.

BY DR. S. P. BARTLETT, OF QUINCY, ILLINOIS.

(Read by Dr. Smith.)

This point of view being so rare as to be almost unique, it may be wise, perhaps, to give some of my reasons for holding it, in order to free myself from possible suspicions as to my complete sanity on the subject.

As I understand it, the work of the fish commissions was designed to produce the greatest amount of benefit to the greatest number of people, the question of increasing the supply of food entering into it to as great a degree as the financial interests involved. The work necessarily has to cover localities of various and contrasted conditions, and in fitting it to such conditions it naturally follows that no one locality can be taken as a criterion as to the results which may follow the same methods in another locality or state. It is my purpose to endeavor to show that the introduction of the carp into the waters of Illinois by the United States Fish Commission, was a wise proceeding, and one that will do more toward causing these waters to produce their full quota of food than any other plan ever worked for the interests of this locality. I am aware that the waters of all the states are not so well adapted as natural homes for the carp as are those of Illinois; perhaps a brief explanation of the reasons for this may be in order. I have watched this branch of the work carefully, and while I may be a trifle more enthusiastic than many of my fellow workers, it is possible that my knowledge of conditions and results justifies my position.

I have been here a long time and my intimate acquaintance with the waters of Illinois has given me a better knowledge of the facts than that of the average man, at least, and I have seen the depletion of the fishes indigenous to those waters continue year after year, through wanton waste and lack of protection, until the fish industry, once great in its proportions, had dwindled to such a degree that the wholesale fish dealers were practically "down and out."

Owing to the peculiar conditions governing them, the waters of Illinois have been great breeding places for the coarse fishes. Thousands of acres of the low grounds are inundated every year along our great rivers, at the season when the buffalo, the greatest commercial fish of the state, are "rolling" or spawning. At this time great quantities of buffalo were easily taken, and they were shipped in large lots to the greater markets, principally to St. Louis, on commission, to the wholesale dealers, and the markets were frequently so glutted with fish that sales were almost impossible, and the freight was hardly realized. During the "sixties" the Mississippi river had two lines of steamboats running daily between St. Louis and St. Paul, and the Illinois river had as many, running between St. Louis and Peoria, and at every landing sugar hogsheads packed with buffalo were offered for shipment to St. Louis. At the wharf here at Quincy, I have seen so many hogsheads of fish offered for shipment that only a small part could be taken, as the boat was carrying shipments from all points above, and could take only part offered at each landing. At this time the boats offered almost the only facilities for the transportation of freight between river towns, and enormous quantities of freight drawn from the country back of the rivers naturally accumulated at these towns, and nearly always more freight was offered than could be taken, and although preference was given to perishable articles, still the fish were brought in such quantities that it was impossible to handle them all, and a great waste resulted. This was at a time when there were no protective laws, and it was possible to take fish anywhere and in any way. It needs but a moment's consideration to see what this wholesale waste would lead to. The supply could not long sustain it, and the inevitable result must and did follow, the practical depletion of the waters. Well, to be brief, the buffalo practically disappeared, and the large concerns engaged in fishing as an industry gradually dropped out, until only an occasional small concern was left, depending on local trade for maintenance. Later, protective laws were enacted, but were little observed, the fishermen resenting any interference with what they considered their natural, vested rights, and only by the education of the people generally to the necessity of a proper

protection could any progress be hoped for toward a proper enforcement of the laws. The buffalo increased slowly, if at all, and instead of the former great runs in early spring, there was no perceptible increase. Then the carp was introduced. Literature on the subject showed it up as a great fish, immensely prolific and of rapid growth, all that was required was a mud hole and a dozen carp to insure a year's supply of fish. The farming community went wild over them, and in a single year 3,000 ponds were constructed or arranged for the raising of fish in Illinois. I remember well the first carp Illinois procured. We were allotted a few hundreds and they were taken to St. Louis, and by some mistake, were put, with the Missouri allotment, in the Forrest Park ponds. The State Commission, of which I was one, went to St. Louis and insisted on having our share. The ponds were seined and I think I managed to get ninety-two of our allotment. Twenty-two of these were placed in the Sni Ecarte to save them, and the rest were issued, in lots of five, to various applicants. The next season the U. S. Commission had a large supply and Illinois was given a generous amount, so that every applicant possible was supplied.

Again the effort to get something for nothing prevailed, and any old mud hole was utilized to raise the carp in. Hogs, and stock of all kinds, ducks and geese, had access to these ponds, but the carp, true to their nature, lived and grew fast, and as spring approached, began to show on the surface of the waters. From these conditions they were taken and cooked and naturally proved a disappointment, soft, oily and muddy in taste. With the help of the county papers they soon got a bad reputation, and why not? Black bass, under the same conditions, would do the same. Then the ponds were neglected and soon became broken, and the carp escaped into the creeks, and from thence into the larger streams, until in time they became well and thoroughly stocked with carp. Fishermen began to take them, but threw them away as worthless, for their name had gone before them; with so much adverse criticism they had been condemned from the start.

Then followed a year in which more intelligent attention was given them. Men made ponds for fish culture and gave their fish the same chance they gave their stock or poultry, good

food, good water, and intelligent care. When they were wanted for the table they were properly treated and properly cooked, and they found the carp at least on a par with the former favorite coarse fish, the buffalo, and gradually they came into more general use. The quantities obtainable attracted the attention of eastern parties, and investigation was followed by a steady market and demand for them. Carp have found their way into every city and town of the west, and on almost every table. Not always on the bill of fare as carp, but under various names, from carp to salmon, it is served to the public daily. All this has, of course, followed only as a result of a better knowledge of how to care for carp and how to cook them.

Now, we again find great concerns handling thousands of tons of coarse fish from the Illinois and Mississippi Rivers to the east, and thousands of men are given employment in the work incidental, and a number of towns are absolutely supported by this industry.

Gentlemen, conditions are following the text, the greatest amount of food for the greatest number of people for the least price is being produced, and the introduction of the carp is responsible for it.

It is not necessary for me to undertake to prove that, from a commercial standpoint, none of the other varieties of fish compare favorably with the carp as a money or food producer, speaking of Illinois waters only, but a constantly increasing supply of the gamier varieties goes to show that their introduction has not only given more food for man, but has increased the supply of food for the game fishes, as well.

I think I have shown that I am a friend of the carp for good reasons. It is adapted to such waters as the Illinois River and the lakes adjacent to it. It is in no sense a destroyer of other fishes, being a vegetable feeder, except as it disturbs the vegetable growths and, in a way, drives out some species into clearer water. It is of commercial value, being hardy, prolific and of rapid growth, and being tenacious of life is easily transported, and it is a good food fish, cheap and wholesome.

I am conscious that our state is especially fortunate in being able to supply the conditions most favorable to the successful cultivation of the carp, and regret that so many must, of neces-

sity, live in less favored localities, into whose waters the introduction of the carp would be detrimental, but without wishing to seem patronizing or boastful under superior advantages, I must insist that the work of investigation and introduction of the carp has been one of the best, in its results, of all that has been done by one of the greatest food producing factors of the world, the United States Fish Commission.

DISCUSSION.

President: In several of the former meetings of this Society, this carp question has been very prolific of discussion. It is now before you.

Mr. Meehan: This subject has been threshed out a good many times, but there is a little I would like to say. I have often heard that there are two things that it is idle to discuss, one is religion and the other is politics, for the reason that when two partisans of either get together, when they are through they hold the same position as they did before. I think we ought to add carp to that list. There was once a man who had a horse of which he thought a great deal and he was very enthusiastic about it. He got around among a lot of his friends one day and began to describe that horse and tell of its beauties, health, etc., and wound up by saying: "This horse is just about the right size, 16 feet high!" A friend said: "Surely you mean 16 hands." "Wait a moment. If I said 16 feet high that horse is 16 feet high, and it is going to stay 16 feet high." There is also an old Latin saying, *De gustibus non disputandum*; about matters of taste it is idle to discuss.

For these reasons it is really, I suppose, idle to have any extended discussion on this subject. But I have often wondered whether or not, in states where people are very friendly to the carp and strong advocates of it, the fish were different and had different habits in those states from what they have in my own. I must say that I have eaten Illinois carp, and have not found them any better than the carp taken from our own waters.

It has been said on various occasions by advocates of the carp, that they do not eat spawn. It has been said for years and years, and they have also stated that there has been no

proof offered that they eat spawn. In fact no later than yesterday, one of the members here made the statement in his paper, that all charges that carp eat spawn were mere pipe dreams. It must have been a pipe dream on my part then, for I have seen them eat spawn, I have written about it, I have stated it in the newspapers, in the fishing magazines and spoken of it to the people; and almost invariably the reply would be: "Well, this is the first time that any regular out and out proof has been given of the fact, but you must remember that other fish are cannibals, too." The trouble is, however, that in a few days we will find the very same people get up again and say, "There is no proof that these fish eat spawn." So I say it is practically idle to discuss the matter.

In Pennsylvania the carp do eat spawn, and the majority of the people of Pennsylvania believe that they live entirely on spawn. I do not agree with that, nor do I agree with the majority of the people in Pennsylvania in the statement that the carp is a principal factor in the decrease of the number of black bass. They are decreasing, but I do not believe carp is the principal factor. I think we must look for other causes. But we claim that carp is a nuisance in our streams; that it is one of the factors in some of the localities of the depletion of black bass and other valuable food and game fishes (and by valuable I mean not merely from a sporting standpoint, but from a food standpoint); and that it is therefore not a desirable fish in our waters.

I can very well understand how Dr. Bartlett could be a great friend of the carp in Illinois, from a money standpoint. Pennsylvania pays a great deal of money to Illinois for carp. The state of Illinois may sell from 1,000,000 to 2,000,000 pounds of carp to Pennsylvania, the bulk of which goes to Pittsburg and Philadelphia. Nevertheless, it is regarded by us in Pennsylvania, and is undoubtedly, a very inferior food fish. While we sell a great deal of carp in Pennsylvania, it is only sold to two classes of people, one a very estimable class, who buy the fish alive in order that they may kill them according to their religious rites; the bulk of the fish are, however, sold to what we consider largely a very undesirable class of people, the Italians. The price is high, running sometimes as high as 16

to 18 cents a pound. But when they mix the fish up with potato, turnip, garlic, onions, herbs and bread, it makes a very cheap dish for them, and perhaps the condiments hide the muddy taste of the fish.

I think myself I am prepared to modify my former opinion of the carp for cultivation purposes, to this extent: If they can be kept or raised in ponds where they cannot get out into the open streams, and can thus be prevented from diminishing the supply of fish in those streams, I am in favor of so raising them; because I believe as long as an industry can be made out of any fish that it should be to a certain extent fostered. But it is not a suitable fish for the streams of Pennsylvania, most of which come from the mountains, naturally pure, and these fish befoul these waters.

They do destroy plant life. There is no question about that with us. It cannot be disputed in Pennsylvania that they destroy the water vegetation, and destroy it in large quantities. It is also undoubtedly true that they keep the water muddy and drive the bass and other fishes therefrom.

By destroying the vegetation in the water they destroy the minute animal life on which bass fingerlings thrive.

Not only bass but other and game fish are deprived of food and shelter by the carp.

It is for these reasons that I am not a friend of the carp, and why I have opposed its further introduction in waters, and why I have heartily approved in Pennsylvania of the enactment of a measure which makes it a misdemeanor to plant the fish in any public waters in Pennsylvania.

In short, I consider the German carp undersirable fish.

Mr. Atkins: The trouble seems to be that people allow themselves in matters of taste to be led by prejudice rather than be controlled by careful judgment. There is quite a general prejudice against the carp throughout the country; but in Illinois the carp is found to be a good thing.

It might be a surprise to some who are fond of black bass and have a high opinion of it, to know that there are sections of the country where for fifteen or twenty years past there has been constant opposition to the black bass. That is the state of

things in Maine. But the black bass is not to blame for that. It is a good fish, well worthy of introduction. But the people who first caught it were for some reason disappointed about it; or they did not catch the other fish that they had gone after; so they began to curse the black bass; and the next man caught the disease and the prejudice has become almost universal. I cannot recollect an instance of having heard any citizen of the state of Maine speak respectfully of the black bass.

Now I am inclined to think the trouble about carp arises somewhat from a similar source. People do not wait to investigate facts, but are contented to found decisions upon prejudice.

Secretary: For several years I have been very much interested in the discussions of the carp question before the Society, both on the part of those who favor and those who are opposed to the fish. I have noted this fact, that those who speak favorably of the carp speak by the card, they speak from investigation and actual knowledge. But I know that those who speak against the carp do not always speak from actual investigation. This state of things exists in my own state, where there is a strong prejudice against the carp. If I am present at some little gathering it frequently happens that somebody will start off with a tirade against the carp; but come to find out, he knows nothing about it; he assumes that the carp muddies the stream, and destroys the bass spawn. Certain people interested in fishing raised quite a large sum of money last year to seine out the carp from a small lake near Fond du Lac, on the ground that the carp destroyed the bass and the pickerel! They seined diligently for one week and did not find a carp in the lake. (Laughter.) Yet for several years to the presence of carp he has attributed the cause of the poor fishing in that pond. (Laughter.)

Lake Koshkonong is the Wisconsin home of the canvas back duck on its flight from the arctic regions to the south; and canvas back duck have been very plentiful there for fifty years, until within the last half dozen years, when perhaps they have been less plentiful. Shooting clubs and others interested laid the decrease to the carp. They did not realize that a law in the state preventing spring shooting had been repealed; they did not realize that there were ten guns where there used to be one;

that each gun went off about ten times as fast as it used to, and all that sort of thing. So they went at it to seine out the carp. While they were doing this a gentleman in Milwaukee of a scientific turn of mind, investigated the subject, and demonstrated that the canvas back duck did not eat wild celery at all; and that if the carp really destroyed the wild celery it had nothing to do with the duck question. That scientific assertion dampened the ardor of the duck hunters somewhat as to their charge against the carp; however, they went to work and caught carp with seines at Koshkonong Lake. But they discovered that there were more bass in the lake than there were carp. As a matter of fact, they caught comparatively few carp; and therefore the ground that the carp had destroyed the supply of the canvas back duck, does not seem tenable.

Now I am very much interested in this subject and have no prejudice either way. But when there is an under dog I have sympathy for him, and as everybody jumps on the carp, I have been waiting for some positive information, some real investigation, to prove that carp affected the breeding of other fishes, that they destroy the spawn of the black bass, or that they interfere with the spawning beds. Now I think that this paper of Mr. Cole's here, perhaps does not dispose of that subject entirely; but it certainly gives a good deal of strong evidence that carp do not affect the spawning beds of other fishes.

I wish if anybody has any positive information, the result of investigation on this subject, that we could have something definite before this meeting, so that we could tell whether carp were a real injury or not.

Mr. North: We have a great many carp in Ohio, and a very large industry around Port Clinton, catching and shipping carp. There is no question, however, but that the carp are very injurious to duck marshes. They feed on the wild rice, and the marshes are deprived of vegetation; and the ducks absolutely do not come to those marshes which they formerly used to frequent in great numbers; but it appears to me that the carp is with us, and is with us to stay; and you cannot exterminate it by talking. The only way to do is to educate a lot more Pennsylvanians to eat them, and thus reduce the supply. (Laughter.)

Mr. Meehan: It is possible that I may be among those who know nothing whatever about the carp, but one statement I would like to make emphatically, and that is, I have seen carp on many occasions eat spawn; I have seen carp on many occasions muddy the water greatly; I have seen carp root up water plants. I cannot make it too emphatic. I may not know much about the habits of the carp, but I can trust my eyesight.

I have among my force a superintendent who has also seen a great deal of that sort of thing; and a few moments ago he stated to me a matter that he had seen himself. In Lake Erie within a year, a twenty-pound carp which was caught, was found to be simply packed so full of spawn that when it was taken from the water the spawn poured from its mouth; and, furthermore, carp had been seen time and again in the waters of the peninsula adjoining Lake Erie, taking the spawn from the spawning beds.

Secretary: What kind of fish was on those spawning beds?

Mr. A. G. Buller: The carp was seen going on the beds of the pike and eating the spawn.

Mr. Whish: In view of the fact that the carp is an infernal nuisance, although his many friends do not believe it, I move that we lay the spawn matter on the table. (Laughter.)

THE POLICY OF CEDING THE CONTROL OF THE GREAT LAKES FROM STATE TO NATIONAL SUPERVISION.

BY MR. C. D. JOSLYN.

Mr. President and Gentlemen:—When I was called upon by our secretary some months ago to write something upon the policy of ceding to the federal government the control of the Great Lakes, I gladly assented, but according to my usual custom, put off the task until the last minute, and now I must confess that I have not written a paper, so must speak from notes written since I came here.

Until a few years ago, Michigan was engaged in raising and planting whitefish in the lake waters which well nigh surround her. It is safe to say that in this work she was very successful under the circumstances. But after a while we realized that the efforts of a single state, no matter how well directed, were wholly inadequate to meet the demands and accomplish practical results; that unless the work was systematically done all along the Great Lake chain, the work of one state alone would be of very little avail. So an agreement was made with the proper representatives of the federal government, whereby the federal officers took charge of our whitefish hatching stations, collected spawn of whitefish, lake trout, and wall-eyed pike from Michigan waters, and returned 75 per cent. of the product of that spawn to the lake waters bordering on the state. From that time on Michigan has had planted in the waters surrounding her, from 50,000,000 to 250,000,000 whitefish and other fry every year since, at a cost to her of, perhaps, \$300 or \$400 per annum.

At the present time it may be said that probably nearly all of the successful work in planting food fishes in the chain of lakes, is done by the United States government. That it has been successful is beyond a doubt. But the *ultimate* results will in a great measure depend upon proper protection to that work which the federal government is not now in a position to give.

Years ago in many places where whitefish were abundant,

the catching of them was so reckless and wasteful, that they were soon exterminated from those places. Now at many of those points they are reappearing, notably in the Detroit River. All of you who are familiar with whitefish planting know that a planted fish can be told from a native. We know that the fish which are coming in now are the results of planting.

When these fish appear in sufficient numbers they will again attract the attention of the fishermen and will be again exterminated. Without the power to protect its own work it is perfectly clear that even the United States cannot keep up and make good against the reckless destruction of fish that now goes on in that chain of lakes on which eight states border. Each of those states is interested in the great fishing industry in those waters, but every state in the Union is concerned in having the fisheries so conducted that the bountiful supply of edible fish which nature has provided, shall remain for the present and future generations.

In the very nature of things the laws of the different states intended to protect the edible fish supply, are not and never will be uniform. What one state deems wise another does not. Some have a closed season, others have not. Some have it at one time and some at another. The evils growing out of this situation have long been recognized, especially by those living around the lakes. Meetings have been held by representative men from the bordering states and from the Dominion of Canada, but no satisfactory agreement as to what should be done has ever been reached, nor has there been any uniformity of opinion upon the most important questions until last April. At that time such a meeting was held in Chicago and there appeared a determination to get together. The result of the meeting was that we did agree upon several recommendations to be made to the respective legislatures of the states represented. But the sad sequel of it all is that no two of the legislatures agreed to nor followed these recommendations. Some states followed some part of them, other states followed some other part, but there was no uniformity and no unanimity. So that we are just where we started—nothing accomplished.

In the meantime the food fishes, generally speaking, are disappearing from the lakes. Although the federal government

has been successful with regard to some of them, there are others which need looking after, and all sadly need protection which the states cannot give.

"Imported Russian Caviar" is made and put up at Grand Haven, Michigan! It is made mostly from sturgeon's eggs captured mainly from Lake Michigan, but to some extent from the other lakes. This industry has been carried on to such an extent that this valuable fish has been almost exterminated from these waters.

This is a subject which was under discussion at the meeting in Chicago, and a resolution was adopted recommending that there be a closed season for this fish for a long term of years—ten years, I think. Michigan recognized the importance of that recommendation and last winter enacted a law forbidding the taking of sturgeon for ten years. But, let me inquire, of what use is such a law in Michigan unless the other states and the Dominion of Canada do likewise? It is quite true that Michigan, with its two thousand miles of coast line, cuts a great figure in this matter, but it is absolutely idle to say that it alone can accomplish any lasting good.

There is another feature: Even if these bordering states could get together, there is yet Canada to be dealt with. From the head of Lake Superior to the foot of Lake Ontario, one side of this great chain of lakes, except Lake Michigan, is bordered by a friendly but foreign country. Friendly as our neighbors are, willing as they are to co-operate with us, it yet remains that no state can make a valid and binding agreement with Great Britain or any of its provinces. The Province of Ontario, and, I think, the entire Dominion of Canada, are very much alive to the serious condition of the lake fisheries; yet, without a valid treaty to bind them, their legislative bodies, like those of the states, are quite likely to yield now and then to the importunate demands which "vested interests" in the fishing industries may and sometimes do make.

In the circumstances, then, nothing like uniformity can be attained. Still, if the fish of our Great Lakes are not to be entirely destroyed, if they are to be propagated, planted and protected in these waters, so as to produce the best, or even beneficial results, it must be done in a uniform manner, under uni-

form laws, uniformly enforced. It is too plain for argument that this uniformity can only be brought about on our side of the lakes by our national government. So forcibly have these things come home to us who live on the lakes, that at the meeting in Chicago which I have mentioned, it seemed to be the unanimous opinion of those present, that the entire matter of propagating, planting and protecting fish in our inland seas, should be put in the hands of the federal government. This is certainly and surely the only means of saving the food fishes which naturally thrive in them, for those who are to come after us.

It remains to be considered whether this can be done without seriously infringing on the internal police powers of the several states. I most unhesitatingly assert that it can. It will be remembered that quite a number of the powers granted the federal government in the United States constitution were given only after acrimonious discussion. Grave fears were expressed that these powers would destroy the right of the state to regulate their internal affairs. But we know now that they have not. Who now doubts the wisdom of the commerce clause of the federal constitution under which President Roosevelt broke the Northern Securities monopoly. Under it Congress has again and again asserted its right to regulate interstate commerce; yet the Supreme Court of the United States has many times upheld state police regulations of such traffic.

A few years ago the state of Alabama enacted a statute imposing a penalty of \$100, I think, upon telegraph companies which should negligently fail to deliver a message within its borders. A suit was brought against one company to recover such penalty, and it undertook to defend on the ground that the Alabama statute was an interference with interstate commerce. But the Supreme Court of the United States said it was not; that Alabama had a perfect right to inflict a penalty upon the company for not carrying out its contract within her borders.

The federal government carries our mails and regulates their use, and no honest person is harmed by this exercise of federal power.

In fact the people would not now tolerate state regulation of our postal affairs. Federal courts are given jurisdiction in all

admiralty and maritime matters, but no one has ever supposed that such jurisdiction has interfered with the laws of any state on the subject of water-craft, nor with its criminal courts.

Moreover, the matter of preserving the food fishes in the Great Lakes is not merely a state matter. It is one which concerns the entire country; it affects all the people of the country and is therefore a question of national importance. The nation only can deal with it successfully.

May I add a word of sentiment?

I will allow no one to go before me in giving allegiance to my own state. If ceding control of the Great Lakes to the federal government for the purposes just spoken of would in the least interfere with the right or power of Michigan to manage its own affairs within its own borders, then, emphatically, it should not be done. But our experience shows conclusively that it will not.

The structure of our national government is upon foundations laid deep and strong. To my mind the master builder was John Marshall of the Old Dominion state.

It was he who demonstrated to the judicial world that the federal constitution created a nation and contained within itself the power of self-maintenance; that it was not constructed for a day, but for all time. The arbitrament of the sword subsequently demonstrated its physical power.

While each state is a perfect entity with plenary and exclusive power to regulate its own domestic affairs, yet each most loyally yields to the federal government, full and ample power to sustain itself as one of the great and independent nations of the earth.

Jealousy of federal control should no longer enter into the discussion of a question of this kind. We are one people. We are not strangers to each other. The citizen of Michigan is at home and among friends and neighbors in West Virginia, and the West Virginian is equally at home and among friends and neighbors in Michigan.

Our interests are common. Our hopes and our aspirations are everywhere the same. The question of state advantage no longer troubles us. What is the best for *all* is now the question which the true statesman considers. East, west, north and

south all subscribe to the great underlying principle—the greatest good to the greatest number. Our state governments have become permanently welded together into one nation now known and honored as the foremost in all the world. Every citizen of every state is a patriotic worshiper and defender of his country's flag. Everywhere we teach our children to respect and revere it. Every American citizen is proud of his country and proud that it has produced a Roosevelt.

Shall it be said, then, that we fear to make its banner the emblem of authority on our great inland seas over which ride more ships than enter and clear any port in the world? Most surely not. We are not afraid of federal power. We are not afraid of federal encroachment. We stand uncovered before the old flag; the new flag; the flag of the future! Now, as it always has been, always shall be, the flag of the free.

“Flag of the stripes of fire!
Long as the lofty bard his lyre
Can strike, Thou shalt inspire
 Our song.
We'll sing Thee round the hearth!
We'll sing Thee on strange earth!
We'll sing Thee when forth to battle we go
 With clarion tongue.
Flag of the free and brave in blood,
Be Thou for aye the blest of God.”

PROPAGATION AND CARE OF YELLOW PERCH.

BY NATHAN R. BULLER, PLEASANT MOUND, PENNSYLVANIA.

Yellow perch is as widely known as the sun fish sometimes called yellow Ned. Unlike some fishes called perch it is a true perch with the black bass and rock bass as near cousins. It is one of the purest types of the family. It is, in fact, the most perfect type that swims in American waters. It is one of the original representatives of the genus. Far back in the earlier ages of the world, during the period the geologists call Devonian, when fishes were the dominant form of life, perch of a character almost identical with the yellow perch of to-day, formed part of the family.

The yellow perch is found in nearly all the waters of Europe and those of Eastern America, from Labrador to Georgia, and in my opinion should be more extensively propagated, and by successfully doing this it can be made to become commercially valuable as well as affording ample sport for the disciples of Izaak Walton.

By the advice of my chief, Hon. W. E. Meehan, I have taken up the study of the yellow perch, to find out economical methods of propagation, and I will relate what my efforts amount to thus far, and I trust there will be discussion had and ideas advanced by those present who have made efforts in that direction.

In order to demonstrate that yellow perch could be placed in ponds and artificially fed, I placed 500 in a pool 150 feet long by 45 feet wide, varying in depth from 4 feet to 12 inches. We commenced to feed with ground liver and found that in the course of time the fish took it very readily. From all appearances they thrive and continue in a healthy condition.

These fish, which were yearlings and two-year-olds, were placed in a pool one year ago and are the fish that I received my eggs from, but I would advise that the parent fish should have very large ponds, covering four or five acres if possible, certainly not less than one-fourth of an acre.

April 15 the ice left my pond and shortly afterwards I found perch in the act of spawning, which continued on until the 12th of May. Most of the eggs were gathered in strings after the fish deposited them on the branches which I placed in the ponds for that purpose, and they were therefore very easily collected. When the intention is to hatch in a pond instead of allowing the eggs to remain on the branches, gather them and place on egg trays, allowing the trays to float loosely over the pond, the action of the waves will keep the eggs free from sediment.

At the present time I am unable to say how successful my pond work will be, as I do not intend to draw off the water until the month of September.

The method that appeals to me as being the proper one to pursue, is the using of a series of troughs 16 feet long, 18 inches wide and 8 inches deep. Eggs can be placed in the troughs on trays. A trough of the dimensions I have mentioned has a capacity of 10,000 perch until they are three months old. They will readily accept milk-curd as soon as the sac is absorbed. I continued feeding the curd until they were twelve days old, and after that I fed them on ground liver, which was taken very readily. In my observations I have not found any disease of any kind to attack them.

I have also been watching very closely to discover any indications of cannibalism. Thus far I have not detected any.

I verily believe that by using these methods and growing the fish to the size here exhibited, our rivers and inland lakes will soon again teem with these fish.

DISCUSSION.

Mr. Buller said while reading his paper: I have a few specimens in a bottle that I have fed on milk curd and beef liver.

(Exhibited.)

I know these can be hatched in jars.

There is a chain of lakes in the state of Pennsylvania covering five counties, and these lakes are kettle holes, varying in size from 150 acres to a thousand; and I think there are 192 in the chain. Long years ago these lakes were practically all inhabited by brook trout, but by the denuding of the forests the brook

trout have disappeared, and to-day they are inhabited by yellow perch, pickerel and bass. The object of this work is to discover methods to grow these perch economically, and restock these lakes by changes of blood from one lake to another, and if anyone has done any work in this respect we would like to hear from him.

The eggs are placed on the trays in lace form; and another thing that I observed of this matter is this: I had placed grasses in the ponds and eggs were deposited on the grasses; but I found that the action of the waves had taken a great many of the eggs off the grasses, and they fell to the bottom and smothered; but by measuring them up after the fish had spawned and placing them on the trays, that was avoided, and for that reason I used the tray.

Mr. Harron: To handle yellow perch eggs on troughs would require a great many troughs, would it not?

Mr. N. R. Buller: They can be easily handled.

Mr. Meehan: Is not the trough made particularly intended for the purposes of distribution in our inland streams?

Mr. N. R. Buller: Yes. To plant the fry in large quantities it is necessary to use jars. The trough would not be practicable for that purpose.

Mr. Harron: I undertook to hatch them at our station, but found I could not do so. You can easily develop them in troughs, but you cannot hatch them loose in troughs, I understand, for they become like a mass of jelly, and so buoyant that they will float down and constantly clog the screens.

Mr. Buller: I have found no trouble in handling them on a tray.

Mr. Titcomb: How many to a tray?

Mr. Buller: About 50,000. I intended merely to raise 10,000 fingerlings.

Mr. Titcomb: Did you raise 10,000 fish to the fingerling state?

A. Yes.

Mr. Harron: They did nicely until about ready to hatch, and then we had to transfer them to our collector courier, and they were placed in there as a solid mass, and hatched out 88%. But it requires constant care and attention to prevent smothering from dead corners of waters, that is, where there is not a complete circulation of water through the bottom of this tank. My idea is that the best way to handle perch eggs on a large scale, is in an open mouth jar with a spout attached so as to pass the young from the hatching vessel to the receiver.

Mr. Buller: I agree with you, when you hatch the fry in large numbers.

Mr. Titcomb: It is remarkably good work to handle 10,000 fry in those troughs. What is the loss?

A. The loss is very light.

Q. Do you count out your fish?

A. Yes, sir.

Mr. Titcomb: I think that is remarkable.

Mr. Buller: I found very little trouble after the sac period. They took food very readily and I brought up these questions because I think the matter is very important to our inland lakes.

Mr. Meehan: Did you not find this successful on a large scale, I mean the mere hatching, by using the trays on the ponds as you describe, simply putting the eggs on the trays and allowing the trays to float loose on the pond?

Mr. Buller: Yes.

Mr. Meehan: There is another question and that is the temperature of the water. We found where the water was cold, just about the time the eggs were hatching out, a large number of fry died. It fell to 44° and little fish died by the thousand.

Mr. N. R. Buller: I took some of the eggs over into the trout department, put them into those troughs, and the temperature of my spring water at Pleasant Mount, is 47°; and they all died in twenty-four hours.

Mr. Harron: At what temperature did the fish begin spawning?

Mr. Buller: I dont know what the temperature of the pond was.

Mr. Harron: My experience is they begin always at 42°.

Mr. Buller: I notice in all our lakes, as soon as the ice has left the lakes, the fish commence to work.

Mr. Titcomb: Did you try transplanting the yellow perch eggs in considerable numbers any considerable distance?

Mr. Buller: No, but I have taken the time and have held them on the trays for forty-eight hours.

Q. In water?

A. No, sir, with a dampened cloth, and also had them in cans the same length of time in water, but a great many of them smothered. But on the dampened flannel trays they were all right.

Mr. Meehan: We shipped some eggs from Erie to Bellefont, about 250,000, in cans. Many of them hatched on the way, and the bulk of the eggs that arrived were dead.

Mr. Titcomb: Did you aerate the water?

Mr. Meehan: Yes. In one instance I accompanied the eggs myself. It was remarkably cold all the way through. The temperature of the water remained stationary, 44°, from Erie to Wayne; and the fish began to hatch shortly after the car moved; but they died almost as fast as they hatched, and before we reached our destination nearly all the eggs that were not hatched were dead.

Q. Do you consider the experiment conclusive?

Mr. Meehan: I should call the shipment of eggs in cans in this manner, a failure under those conditions.

Mr. A. G. Buller: How do you place your eggs, in jars?

Mr. Harron: I hatched them nearly all in the open tanks.

Mr. A. G. Buller: What would be your method of putting

your eggs in the jar when you use the jar? Do you just lay them in the jar?

Mr. Harron: I place them in the jars, just let them drop right in, without suspending them from a string, placing about 260,000 eggs in a jar.

Mr. A. G. Buller: I tried that in the Erie hatchery and I found when the fish were about ready to hatch out that they were smothered, and few eggs came out, and what did not come out were smothered. Perhaps I did not run enough water.

Mr. Harron: I ran about two gallons. In the future I propose to hatch them all in the jars.

Mr. Buller: My experience was that about the time they were hatching out they died. What few came out died and what did not come out smothered in the egg.

Mr. Harron: The fry rise very readily after hatching, and there is no reason why they should die in the jar.

Mr. Buller: Probably I did not have enough water running.

Mr. Titcomb: At another one of our stations we decided that the open pump, Downing jar, is the best thing for hatching yellow perch eggs. I hope that there will be further experimentation on the subject of transportation. It is possible for the bureau to go to the head of Lake Champlain and take hundreds of millions of yellow perch eggs. The yellow perch on Lake Champlain is a drug in the market. When the water rises in the spring these perch go into marshes and spawn, and the spawn is left hanging on the weeds as the water recedes; so it is possible to collect hundreds of millions of eggs—gallons and gallons of them.

Mr. Meehan: We intend to pursue this matter, because of the conditions that exist in portions of our state. With us it is a question of propagating these fish in enormous quantities. We must do it. It has come to a point where for a greater part of the state it is necessary to hatch them in that way, and we intend to limit ourselves by our capacity to get them out, so that it will become a question of successful transportation.

Mr. Downing: A few years ago I had a little experience in

hatching yellow perch. I did it as an experiment. I was engaged in another work, but I had a chance to get a few of the eggs, and I carried them from North Bass Island to Sandusky, in a pail and in a pan. When I got to Sandusky I found a large part of the eggs stuck to the bottom of the pan, and I saw that if I removed them from the pan I would injure them, and I left them in the pan and turned a small stream of water on them and arranged them so that the water would go into a screened box; and the others I put into a jar. In putting them into the jar I let them wind right around the tube, and in eight days they hatched, and so far as I could see they hatched 100%. I did not see that any died or were wasted; and it seemed to me at that time, that it was a very easy matter to hatch that kind of fish.

Mr. Harron: I would like to ask Mr. Downing if he noticed the temperature of those that hatched in eight days.

Mr. Downing: Pretty high—about 70° . That was some time ago and I do not exactly remember the temperature.

Mr. Harron: My experience is that it takes the yellow perch egg 10 to 20 days to hatch out at a mean temperature of 47° to 54° .

Mr. Townsend: We have had a half bucket full of eggs which kept in good condition and 30,000 to 50,000 hatched out each season.

Mr. Buller: How far had the eggs advanced?

Mr. Townsend: They hatched pretty promptly. The further the eggs are advanced the harder it is to transport them.

Mr. A. G. Buller: That was the trouble with the eggs that Mr. Meehan took; they were hatching on the way; and also with those that I sent to Bellefont—they were practically all hatched out. The eggs Mr. Nathan Buller spoke of were green eggs and not difficult to carry; but as for carrying them any distance on trays when they are ready to hatch I do not think it can be successfully done.

Mr. Meehan: There does not seem to be any limit in reason to the number of yellow perch that may be carried. You can carry nearly as many yellow perch in a pond as you can of trout

relatively. They do remarkably well, and feed on the same food readily.

Mr. Nathan R. Buller: Most all my eggs were gathered green, and I found the trays gave the best satisfaction carrying green eggs in water. While they had all the attention possible I found a great many of them were dead. I don't say carrying them half a day, but these experiments of holding these eggs were for a couple of days. And I have also taken the eggs from the lake and carried them on the trays and placed them in the evening, and had perch in the morning, and they went through successfully. I brought up this question about the perch in the pond because I believe that it can be made a very fine pond fish with pond culture, the same as trout, if we do not run up against something next year that we did not see this year.

Mr. Downing: I would like to ask if the eggs handled were taken from the fish?

Mr. Buller: Most of the eggs were gathered. I expressed some of the eggs; but the natural impregnation was much better than mine was.

Mr. Downing: In my experience I took the eggs from the fish.

Mr. Buller: The natural impregnation was better than mine.

Mr. Lydell: Some years ago when I was collecting wall-eyed pike spawn in the Saginaw district for the Michigan Fish Commission, I had opportunity to take a great many perch eggs, and we used to strip them as they came aboard of the boat in great numbers and turn them over into the bay. At one time we stripped a large pail full of them and sent them down to the hatchery at Detroit. We took the eggs ourselves right from the fish and put them in a jar that had some cross-sections in it, and the eggs were wound around in there so that they could not float up against the screen. They apparently did hatch, and after the last egg had hatched, I either drew upon my imagination a great deal, or they seemed to commence hatching from the gelatin after that. (Laughter.) I did not know exactly when it was going to stop.

Mr. Whish: In New York state the yellow perch is a favorite fish, and although we do not attempt to raise them we distribute them, because we find that where there are a lot of yellow perch to be caught in the ponds, the small boy and the average fisherman are satisfied to catch them, and do not bother the better class of fish. There are certain small streams running into one of the lakes, and in these streams the small perch seem to come up from the lakes. I have always thought they came up to escape the large fish. At any rate, we take advantage of their coming and simply go there with a little net and cans, and scoop out millions of them in the fall and ship them as fingerlings. I might also say for the edification of the yellow perch brethren, that I would as soon catch yellow perch on a light rod as trout. "If that be treason, make the most of it." Yellow perch sometimes grow to a weight of four pounds in New York state, and if any gentleman wants to know where those perch are found, I will send him a map of the district.

Mr. Meehan: I think one of my superintendents, Mr. William Fuller, of Corry, was the first in Pennsylvania to begin the work of experimenting on yellow perch, and he will tell you something about expressing the eggs from the fish themselves.

Mr. Buller: I had no trouble in placing them and they fertilize just as well as any.

Mr. Harron: I think Mr. Downing spoke of the egg sticking. I have made some little experiments with the impregnation of the eggs, and I found that it was always the case that they did stick for a while. In the case of the eggs that I collected from the fish, whenever I would hoist the car to take out the eggs I did not find a single string attached to the car. They were all loose and floating buoyantly over the bottom.

Mr. Downing: One reason that they stuck so persistently to the bottom of the pan was, that the pan was a little bit dry when the eggs were put in, and they adhered to the bottom and they stayed in the pan till they hatched, and they hatched as well out of the pan as out of the jar, and apparently they all hatched.

NOTES ON THE TAKING OF QUINNAT SALMON EGGS.

BY WARD T. BOWER.

The quinnat and other salmons of the Pacific are now well established as a staple article of food throughout most civilized countries; and to the extent that they can be produced at a reasonable price to the consumer, the demand for this valuable food staple is certain to grow as population increases. It is evident, therefore, that to maintain a normal balance between consumption and supply, the latter must be greatly increased as time goes on. The future of an important source of food wealth presents a serious economic problem, the solution of which it is now generally conceded depends in a great measure on fish cultural effort.

Assuming then that the future of the salmon industry rests quite largely on hatchery propagation, it is timely to inquire whether production in this way may not be substantially increased through improved methods that practically eliminate all loss prior to the eyeing stage of the ova and, though perhaps of less importance, incidentally effect substantial economies in the cost.

My experience in salmon culture leads to a positive conviction that the single feature of releasing the ripe ova by incision and gravity rather than by expression, effects a saving of 5 to 15% of the ova and reduces the cost of production to the eyeing stage at least 33 1-3%. It is this point that form the basis of the account which follows. Barring perhaps some minor details, no claim is made to originality, for taking salmon eggs by incision has been tried in various ways by others, though perhaps not on so large a scale and during a full season's operations. It is the purpose to describe briefly what may be termed the old and the improved way, make comparisons and submit the results as evidence of the superiority of the one over the other.

In the fall of 1903 and again in 1904, the writer was in immediate charge of the U. S. Bureau of Fisheries Sub-station at

Battle Creek, California, where quinnat salmon have been propagated for a number of years.

A barrier is placed across the stream at this point to prevent the ascent of the fish to their natural spawning grounds immediately above. Below this barrier or rack for a distance of about two and one-half miles to where Battle Creek empties into the Sacramento River, the current is moderate, the stream broadens and is much deeper in places.

About one-half mile below the closed or upper rack, a second or retaining rack has been placed across the stream, so arranged as to permit free entrance to the fish and yet preventing in a great measure their dropping back. The fish are taken by seining at various points between these racks, and range in size from about ten to forty pounds, the average being about twenty. The method of taking the eggs in 1903 is practically the same as had been employed for several preceding years. The ripe females, as fast as caught, are transferred to pens, whence all are removed daily and spawned. The crew for this purpose consists of ten men, as follows: One man to dip the males, one the females, one tail-holder, one head-holder, one stripper for females and two for males, one egg mixer and two egg washers.

A female is dipped from the pen and the net handle so balanced on a rest that the fish is swung a few inches above the floor. While in this position it struggles violently, but is seized at once with both hands by the tail-holder, who wears woolen gloves to secure a firmer hold, and raised to a vertical position. The head-holder, with hands protected by heavy horse-hide gloves, then grasps the fish by inserting his thumbs in its mouth and his fingers under the gills. The tail-holder, resting upon one knee, brings the tail of the fish to the floor and the vent just above the edge of the spawning pan, a rectangular vessel similar to the ordinary breadpan. The latter is placed in a frame to prevent overturning should the fish slip from the grasp of the attendants. The stripper then expels the eggs in the ordinary way, passing both hands two or three times down the full length of the abdomen. As a twenty or thirty-pound salmon has great strength and remarkable contractive powers, it is generally necessary for the stripper to exert his utmost strength to start the eggs, even when they are fully mature; in fact, strength

rather than skill is necessary at this stage. The eggs are then fertilized in the usual manner, a number of males having been thrown out on the platform a sufficient length of time to allow them to become exhausted, and they may be easily handled. The egg mixer stirs the mass in the pan with his bare hands and the pan is then transferred at once to the washers. The eggs are cleansed immediately and turned into buckets, which are placed on an independent platform to prevent loss or injury through vibration or concussion during the extremely delicate stage of adhesion and separation, or until they are fully hardened.

For a number of years past, up to and including the season of 1903, it has been the practice at the Battle Creek station to return all females as they are stripped to a separate pen; then, after the day's stripping is done, throw them all out and kill and open them to secure the 10 to 15% of eggs that remain after stripping or that cannot be obtained by pressure. The eggs taken by this secondary process, designated by hatchery employes as "butchered eggs," are not equal in quality to those stripped, though nearly so, and are well worth saving. The heavy pressure exerted on the vital organs of the fish during the process of stripping releases a considerable quantity of blood and foreign matter, which mixes with the eggs and necessitates the time and trouble of washing them several times in a normal salt solution.

Fishing and spawning operations at the Battle Creek station were carried on during the season of 1903 as above outlined.

During the season of 1904 the fish were caught in the same manner as in 1903 and preceding years, but a radical change in one important point of spawning the fish was decided upon. Instead of forcing the bulk of the eggs by main strength and securing the remainder by opening the fish, they were taken by the simple method of incision and gravity. The spawning crew is the same as under the old method, with the exception that one man, the head-holder, is entirely dispensed with. The female is dipped up as before, grasped by the tail-holder and laid on the floor. Immediately the man who occupied the relative position of spawn-taker in the old method, strikes a sharp blow on the back of the head of the fish with a hammer, causing instant death. The tail-holder then releases his hold and inserts

one finger in the gill opening and raises the fish to an upright position, the vent being above the edge of one side of the pan with the abdomen towards the "spawn-taker." The latter, in a kneeling posture, grasps the tail with his left hand in order to keep the fish from swaying, while with his right hand a knife is inserted between the pectoral fins, and with a single vertical movement of the arm an incision is made down the entire abdomen of the fish to about one-half an inch to one side of the vent. The eggs immediately pour in a mass into the pan below, gravity being the only force exerted upon them. They are then impregnated in the usual manner. An ordinary pocket knife is used for cutting, the end of the blade having a keen edge to facilitate the rapidity of the work. It is essential that not over an inch of the blade be allowed to penetrate the fish, for fear of cutting some of the eggs. This is easily managed by firmly grasping the blade an inch or less from the point between the thumb and forefinger, which serves well the purpose of a gauge while making the cut.

Practically no blood falls into the pan following a quick, sharp incision, thus avoiding the necessity of previously bleeding the fish. In the methods of incision heretofore tried—most of which have been in an experimental way—it seems to have been considered necessary to bleed the fish before making the cut for eggs. But in practice it is found that but a mere trifle of blood flows from a simple incision of the abdominal walls, so long as no vital parts are cut or forced. Preliminary bleeding appears to be a waste of time and effort without any advantages.

The point may be raised against the plan of killing the fish in advance of taking the eggs, that considerable loss may be occasioned by killing green fish, whereas in the old way the fish could be tried and then returned to the water if unripe. In practice, however, we find that if ordinary care and skill be exercised in sorting the fish at the time of capture, the number of green fish cut is reduced to an insignificant minimum.

The total number of females stripped during the season of 1903, when the eggs were taken by stripping followed by cutting, was, in round numbers, 4,200; total number of eggs taken, 27,343,000; eyeing percentage, 79.

During the season of 1904, when the method of incision and gravity was tried the first time for a full season's operations, the number of females stripped was 9,400; number of eggs taken, 58,068,000; eyeing percentage, 97½.

In making a comparison between the fishing and spawning work of the two seasons, it is only fair to state that weather conditions were considered somewhat better in 1904 than in 1903. The increased catch in 1904 was not due to a heavier run of fish but to the fact that in 1903 a sudden flood carried away the upper rack in mid-season. But so far as spawning results are concerned, if there was any advantage in 1904 over 1903 it was probably offset by excessive crowding in the hatchery in 1904 and also by the bad condition into which the hatching equipment had fallen for want of an appropriation to replace it.

The most striking point of advantage of the new method is the improvement in the quality of eggs obtained, the loss under the old plan being 21% in 1903, while under the new plan it was a trifle less than 2½%. No doubt the difference would not be so great every season, but the writer firmly believes that the eyeing percentage should never fall below 95 with the improved plan, under any and all weather conditions.

It seems reasonable to assume that the improvement in the quality of the eggs is due chiefly to the elimination of the heavy pressure on the soft and delicate ova, that is necessary to start the flow. It is true that as soon as the eggs are started the pressure may be somewhat lessened, but a great deal of force must still be used to resolve the mass of eggs into a small liquid stream through the vent. The unnatural force thus brought to bear unavoidably subjects the eggs to the danger of crushing and straining, and also starts and expels a part or all of the green eggs that should not and need not be taken. Incidentally it should be noted that a limited number of green eggs are present in nearly all salmon spawned at the right time, for if the taking of the eggs is deferred until the last one is ripe, loss by hydration of those nearest the vent frequently occurs.

That some eggs are crushed in stripping is evidenced by the fact that shells are washed from nearly every pan; and it seems reasonable to suppose that a pressure sufficient to rupture even

a small percentage of the eggs is responsible for additional loss before the eyeing stage, if not afterwards.

But if there were no improvement in the quality of the eggs taken by direct incision of the female, the saving in labor and expense by this method strongly commends its general adoption in quinnat salmon work. The old plan requires two handlings; first, to spawn by hand, and then to kill and cut for the purpose of securing the remaining 10 to 15% of so-called "butchered" eggs. With a well trained crew it requires but little more time to take all the eggs at one handling by the clean and quick method of direct incision than it does to take the "butchered" eggs; thus one handling is entirely cancelled. In practice, we found that 100 females are spawned by direct incision in less than one-third the time required by hand stripping followed by cutting.

Furthermore, the old plan required two crews, one for fishing and one for spawning, the latter sometimes making a few seine hauls near the close of the day. In 1904, working under the new plan, the regular fishing crew was entirely dispensed with, and a single crew attended to all of the fishing and spawning, the daily spawning work being ordinarily cleaned up by 9 o'clock in the morning. Seven less men were used for this work in 1904 than in the preceding year.

Another considerable item in the line of economy appears in the hatching house. To eye the 58,068,000 eggs on a 97½% basis means that only one-ninth as many eggs must be picked out by hand as though the eyeing percentage were only 79. If we concede one-third of the improvement in quality to weather conditions or other causes, there is still a heavy balance to the credit of the improved plan.

To sum up: In 1903, under the old plan, sixteen men in thirty days caught 4,200 females, from which 27,343,000 eggs were taken and 79% eyed.

Under the improved plan the year following, nine men in sixty days caught 9,400 females, from which 58,068,000 eggs were taken and 97½% eyed.

The comparison between the two seasons is a fair one, for although a sudden flood stopped the work thirty days after the

opening in 1903, the take of both eggs and fish was not equal to that of the first thirty days in 1904.

The operating cost of fishing and spawning in 1904 was approximately \$12.00 per day less than in 1903, and this does not include the saving in the egg-picking account, which was about \$10.00 per day.

Simplicity, expedition, a decided improvement in the quality of the eggs, and economy all the way to the eyeing stage—these are the salient points to the credit of spawning quinnat salmon by direct incision. The results speak for themselves.

COLLECTING, HATCHING AND DISTRIBUTION OF PIKE-PERCH: WHY THE GREAT LOSS OF EGGS.

BY S. W. DOWNING.

I shall make no apology for this paper, more than to say that our worthy secretary said "write" at the same time giving me the subject upon which to write, and the paper now before you is the result of that writing. But you must expect nothing flowery in this article; I tried that once and the result was such that I am willing henceforth to abstain from anything in that direction, the incident was this:

While in charge of the work at the Clackamas, Oregon station, I had occasion to visit a sub-station upon Elk creek, a tributary to Rogue river, and in a letter written home describing the Steelhead trout as seen trying to ascend the rapids, I borrowed from Quackenbos in his description of the "Golden trout" and wrote as follows: "The coloration is gorgeous beyond example, the deep purplish hue of the back and shoulders seems dissolved into a dreamy sheen of amethyst through which the inconspicuous pale lemon spots of midsummer flame out in points of lemon or vermilion fire, while below the lateral line, all is dazzling orange."

This was so entirely foreign to my plain way of expressing myself that my wife became alarmed, and in her next letter she said, "When I commenced reading your letter, I thought that you were describing a fish, but before I finished was not sure whether it was fish, a bird of Paradise or a rainbow, and I think that you had better come home at once, or use some other brand of liquor." This was enough for me, and I determined right there that from that time all my writing should be in the plainest language possible.

So I will endeavor in my weak way to first describe the manner of collecting the eggs.

The eggs collected by the force sent out from the Put-in-Bay station are secured from the fish caught by the commercial fisher-

men. A spawner, as the men comprising this force are called, going in each boat, and as the fishermen raise their nets and the fish are thrown into the boats, the eggs from the live ripe fish are collected. By ripe fish we mean those ready to deposit their eggs. I think that I can describe this process no better to those assembled here than to give the instructions that are handed to each new man that is put into the field, after first stating that each spawner is provided with an outfit consisting of a wooden pail, one or more wooden kegs, a dipper and two common milk pans.

Instructions to spawners: Take the eggs from *one* female if large, and not more than *two* if small, use plenty of milt, and stir with the naked hand carefully, being sure that the milt from the male fish comes in contact with every egg, let stand about half a minute, add a little water and gently stir again, then lower and empty carefully into the keg which has previously been partly filled with water. Continue this process until the keg has as many eggs in it as it will safely carry. After the eggs are all taken then add a little water at a time until the keg is full. In adding the water do not pour it directly onto the eggs, but against the inside of the keg. After the keg is full then pour some of the water off, being careful in so doing to not pour the water down so low that the eggs will be exposed to the air, as this will cause them to form into a cake at once. Continue to add and pour off water until the eggs are thoroughly washed free of milt, and hardened up, after which time change the water as often as once an hour while in your possession, or until you put them onto the trays for shipment to the station.

As will be gathered from the "Instructions to Spawners," some of them are located in fields near enough to the station so that the eggs are picked up by the boat kept for this purpose, and brought to the station in the kegs, other kegs being left with the spawners for the next day's collection; while others are sent to fields so remote that this can not be done, in this case the eggs, after becoming fully hardened up, are evenly spread on cotton flannel trays, the trays placed in cases made especially for the purpose, and shipped to the station. Owing to storms and other causes, the shipment of the eggs from the field is often delayed for several days, the eggs remaining in the cases during this time, and usually with no apparent bad results.

After the eggs reach the station they are washed off the trays into the large wooden tubs, the common wash tub being used, the name of the spawner and that of the fishermen from whom the eggs are obtained together with the date upon which the eggs are taken, are written on a card and attached to the tub, so that a record may be kept not only of the spawner's work but the date upon which the eggs are taken and the locality from which they came. The eggs are usually left in the tubs over night, the night watchman changing the water on them every hour. The next morning they are placed in the hatching jars, from three to three and a half quarts being placed in each jar. And right here is where the fish culturist's work begins, and we believe that all those who have propagated this fish will agree that it requires more work and vigilance to successfully care for a given number of quarts of the eggs of the Pike-perch than of any others that are hatched in jars. The farmer's boy in describing the work of "watching gap" while the grain is being hauled from the field, very aptly describes the work of the fish-culturist. The boy asked if the fence could not be put up so that he would not have to stay and keep the cattle out of the grain. His father said, "Oh pshaw, boy, that isn't hard work." The boy said, "No, I know it aint, but it is so d—d busy." And this is the case with the fish-culturist's work. He gets the eggs overhauled, siphoned off, and his jars adjusted to his satisfaction and is feeling pretty well satisfied with himself. He then goes away for a few minutes to attend to some other matter, and returns to find the jars full to the top and on the point of overflowing, the eggs in nearly a solid mass with little canals running through them from the bottom of the jars upward through which the water winds its devious way to the top; then there are cuss words, and a strong wish that all eggs of this class were in perdition, but it avails nothing, and there is nothing for it but to take down the jars, pass the eggs through the screen and set them up again.

This year, however, we have been bothered less with this banking in the jars than ever before, and we credit our freedom from it to the use of corn starch. Each spawner was supplied with a quantity of corn starch and instructed to place just enough of the starch in the water to make it of a milky consistency, then the eggs are taken according to the previous

"Instructions to Spawners," and placed in this starch water, milt and all and not washed until all the eggs were taken, when washing was commenced and continued until the water came off clean and clear, all the milt and starch having been washed out, after which the same care was taken with the eggs as though no starch were used, and the result was that the spawners had less trouble in the field, there was far less trouble with the eggs in the jars at the station than on any previous year, and as the number of eggs hatched was one per cent greater than ever before, we feel that there were no bad results from the use of the starch.

After the hatching, then comes the distribution of the fry. Experience has taught us that the fry of the Pike-perch carry the best at from twenty-four to forty-eight hours after hatching, and as nearly as possible the fry from this station are liberated at that age, and those liberated in Lake Erie, which usually constitutes nine-tenths or more of the hatch, are distributed by the regular force at the station and is accomplished in the following manner:

We have a small steamer which is operated in connection with the station and lies at the wharf but a few feet from the hatchery door. Upon the deck of this steamer are from 100 to 140 12-gallon wooden kegs conveniently arranged for filling with water and placing the fry in them. These kegs are first filled about half full of water, the fry is then dipped out of the tanks into wooden tubs, carried out to the boat and placed in the kegs with a dipper, care being taken to put as nearly the same number into each keg as possible, they are then taken out into the lake and liberated. This is done by pouring them out of the keg, water and all, into the lake while the boat is running at full speed. This scatters them effectually, as during the time that it takes to liberate a load the boat will have covered several miles, and the hatch of a single season is thus distributed over an area of from 80 to 100 square miles, so that the loss from being overcrowded is reduced to minimum.

WHY THE GREAT LOSS OF EGGS?

This is something that I am unable to inform you with any degree of certainty, but will give you the results of some of the

observations that have been made during the past few years and let you draw your own conclusions, or a discussion may follow that will clear the matter up more to your satisfaction.

Up to last spring I think that we were seeking, at least to a great extent, in the wrong direction for the solution of the question of what caused so large a per cent of poor eggs, and were putting nearly the entire blame upon the spawners, and every time a poor lot of eggs came in we would write to the field foreman telling him that such and such a man was sending in poor eggs, and instruct the field foreman to jack him up about it, the men always protesting that they were doing the best that they could, and as the same men were employed for the whitefish work in the fall, and usually sent in eggs of an excellent quality, I could not bring myself to believe that they would do good work in the fall and intentionally do poor work in the spring, so I commenced looking in other directions for the cause of the inferior quality of the Pike-perch eggs.

In the spring of 1904, I was directed to take six millions of Pike-perch eggs to the St. Louis exposition. These eggs were some of the very last eggs received at the station, and usually the last eggs taken are of a poorer quality than those taken earlier. However, these eggs were placed in the common field cases and crushed ice packed in the space between the trays and the inside of the case, upon arrival at the exposition grounds about thirty hours later the cases were opened and quite a quantity of ice was found in the cases, the temperature of the eggs being about 47 degrees. The eggs were taken out and allowed to stand until their temperature rose to nearly that of the water in which they were to be hatched, which was 62. The eggs were then placed in the jars and at the end of four days were nicely eyed, fully 65 per cent of them eyeing, while the eggs left at the station, collected on the same day as those taken to St. Louis, were twelve days in eyeing and the average hatch but 48 per cent. These results were so marked as to lead us to commence a research along the lines of temperature.

We first compared the record for the past five years at this station, taking the average water temperature during the period of incubation, and the per cent of eggs hatched, the results of this comparison are given as follows:

1901—Average water temperature $49\frac{1}{2}$, gave a hatch of 55 per cent.

1902—Average water temperature 45 2-3, gave a hatch of 47 per cent.

1903—Average water temperature 47, gave a hatch of 53 8-10 per cent.

1904—With an average water temperature of 47, gave a hatch of 48 per cent.

1905—With an average water temperature of 48, gave a hatch of 56 per cent.

It will be noticed that during the hatching seasons of 1903 and 1904 the average water temperatures were the same, while there was a difference of 5 8-10 per cent in the hatch of eggs, and that while the season of 1901 had an average water temperature of $11\frac{1}{2}$ degrees higher than that of 1905, yet the hatch of 1901 was one per cent less.

We think that these facts can be accounted for in this way: During the incubation of 1903, the water temperature during the first three days ranged from 39 to $40\frac{1}{2}$ degrees, from which time it steadily increased until the eggs were hatched, while during the incubation of 1904 at the receipt of the first eggs, the water temperature stood at $39\frac{1}{2}$, rose to 40 the next day and then dropped back to 39 and remained at that mark until the eleventh day of incubation. And during the season of 1901 the lowest water temperature was 41 degrees, while during the season of 1905 the lowest water temperature was 42 degrees, remaining at that mark but one day, after which time there was an increase.

Continuing the inquiry along these lines, we find that the Pike-perch eggs which were sent direct from the field to the Pennsylvania commission and were hatched at Erie, Pa., during the season of 1904 in water of an average temperature of 49 degrees gave a hatch of 68 per cent, and during the season of 1905 the water temperature at Erie stood at an average of 50 degrees, and the eggs shipped in the same manner as on the previous year resulted in a hatch of 80 per cent, while at Cape Vincent, N. Y., eggs sent from the same field and collected by the same spawners, and hatched in water with an average temperature of 43 degrees, yielded a hatch of but 20 per cent; also a record of 10,000,000 Pike-perch eggs sent direct from this

same field to the Duluth Minnesota station in the season of 1904 resulted in a hatch of but 38½ per cent, and while the water temperature at this place is not known to the writer, it is presumed from the geographical location that it is lower than at either Put-in-Bay, Ohio, or Erie, Pa.

We also have a record of 10,000,000 Pike-perch eggs shipped to Mr. M. E. O'Brien at St. Joseph, Mo., during the season of 1902 and hatched in water with an average temperature of 54 degrees, which gave a hatch of 80 per cent. We have still other records at the station, all tending in the same direction, but we feel that enough has already been given to show that the higher the average water temperature during the period of incubation, the greater will be the percentage of eggs hatched.

During the past hatching season the writer was asked if a water temperature of 40 degrees and below was not fatal to the eggs of the Pike-perch, and while my temperature records showed that the temperature had been as low as 39 for several days at a time during the season of 1904 and that our hatching record for that year showed a hatch of 48 per cent, yet to determine if possible how low a water temperature the eggs of the Pike-perch would stand, we had seven quarts of eggs placed in a keg, and by the use of ice the water temperature reduced to 38 and held at that mark for a period of 48 hours, when the temperature was allowed to gradually rise until it reached the normal. The eggs were then placed in the hatching jars and the same care given them as was given the other eggs, the result was that 12 per cent of these eggs hatched, proving that while a water temperature lower than 40 degrees is not necessarily fatal, yet it is very injurious to the eggs, and we do not doubt but that if the eggs have been carried in water of a temperature higher than 40 degrees until after segmentation is well advanced, and then the temperature drop to 40 degrees or lower, the result would be fatal. However, we have not seen this point tested.

During the first few days of the past spawning season the weather was fine, and the eggs sent in by one of my most experienced men were of a very good quality. The weather then turned colder accompanied by snow and rough weather, and the eggs secured by him during this cold snap were nearly worthless. Also the eggs secured by others of the force whom I knew to be

earnest painstaking men, proved to be no better, and from the facts given in the foregoing statements we have arrived at the conclusion that the "Great Loss of Eggs" is not due so much to the manner of manipulating them at the time of taking, and carelessness in subsequent handling, as to the weather conditions, and the consequent effect upon the water temperature after they are placed in the jars, and during the process of incubation.

However, we would not abate one whit from the former care and vigilance practiced in the field, but continue to be as careful and painstaking as possible in every detail, and then hope for the most favorable weather conditions afterward.

DISCUSSION.

Mr. Whish: The state of New York began hatching pike-perch eggs in 1894. The highest take of eggs since the Constatia Hatchery was established was 78,000,000 this season. We base our estimate as to the number of fish we will have for distribution, in getting the application blanks ready for the hatchery, at 60 per cent, and for several years it has been 70 per cent.

Mr. Clark: The paper by Mr. Downing is very interesting indeed, and to me at the present time probably more so than to any other member present, as last spring I collected a large quantity of pike-perch eggs. Of course previously we had collected a great many, but not to so large a scale as this past spring. From the title of the paper, I was in hopes that some of the problems in regard to the great loss might be solved. However, considerable light has been thrown on the subject.

Mr. Downing speaks of the question being asked if a temperature of 40 degrees was not fatal. This was brought up in the correspondence between myself and the Washington office, and at that time I stated in my report that the low temperature was causing a loss. Later on I revised my opinion in this regard somewhat; still I think that there may be times (as Mr. Downing says) when the low temperature may be very injurious.

I wish to state here our experience last season. We took all told, 370,000,000 pike-perch eggs, at two field stations, one being on Saginaw Bay where we gathered the larger number—I think

a total of about 325,000,000—and the other on the St. Clair river. The 325,000,000 collected in Saginaw Bay were taken under circumstances similar to those under which Mr. Downing collected his—from the boats of the fishermen. Out of 197,100,000 green eggs we succeeded in eyeing but 21,150,000, about 10 per cent. The percentage of eyed eggs has always been low in Michigan, but I think never before so low as this.

We want better eggs from Saginaw Bay; for even larger quantities can be taken there than in Lake Erie.

After completing the work at Saginaw Bay, I sent the force to Robert's Landing on the St. Clair river. There they succeeded in getting 17,500,000 eggs, and of that number we eyed 11,250,000, about 70 per cent. These eggs were treated exactly the same as the Saginaw Bay eggs and by the same crew, up to the time they were ready to transfer to the station. From the Bay City headquarters they were moved by wagon and rail to Detroit to the hatchery. From St. Clair river they were taken by row boat to the dock, and there put on the steamer for Detroit. Eggs were taken the same way and handled in a similar manner with the exception of the transportation, and in one case we got less than 10 per cent and in the other 70 per cent of eyed eggs.

Various ideas have been brought out as to how matters can be improved. I have suggested that we establish an eyeing station at Bay City, thinking possibly it might be an advantage. Some believe that the Saginaw Bay water is detrimental. Mr. Downing I think is of that opinion. The water in the St. Clair river is of course very much clearer than it is in Saginaw Bay. The probabilities, however, are that before we establish an eyeing station on Saginaw Bay, I shall ask the commissioner to send a scientist to that point when we establish the field station next spring, to see if we are actually getting eggs that are all right.

First we must see if it is the eggs that are not right, or the milt that is not right, or the water that is used. This low percentage of eyed eggs must be increased. That there is no use of the Bureau taking large quantities of eggs and only getting 10 or 12 per cent of them eyed is evident. We hope to do something to better conditions, and I think that probably the first thing to do is to look into the matter thoroughly with the aid of our

scientific friends. If it is found that we are getting good eggs and the loss is subsequent, an eyeing station must be established near the place of taking. There will be no dearth in the supply, for there are billions of eggs in Saginaw Bay.

Mr. Fullerton: How would you eye the eggs at that station?

Mr. Clark: Mr. Downing's experience is practically ours. At first they appear to be the nicest looking eggs you ever saw; but shortly after that you have the worst mess imaginable; and still 50 or 60 per cent of them will be eyed.

Mr. Fullerton: You will have to get a battery of jars on your fishing grounds at Saginaw Bay.

Mr. Clark: We would simply put up a hatchery, that is all; not temporary, but rather a cheap affair. I have some plans prepared that have not yet been submitted to the office.

Mr. Fullerton: Then you would not hatch them out right there?

Mr. Clark: No, only what are to be planted right there in Saginaw Bay. If we should take large numbers of eggs we could plant some of the fry back in the bay at that point and simply eye and send the remainder to the hatching stations. One of our arrangements with the Michigan Fish Commission was to annually turn over 50,000,000 eyed eggs, which we nearly accomplished this year.

Mr. Fullerton: We are interested in the pike-perch in Minnesota; and our methods are somewhat like those described in the paper read; but we are always very careful, and it pays to have lots of tubs. We use the corn starch very freely and keep a man continually washing them out; and we find the more they are washed with that corn starch water, fresh water being added to the corn starch, pouring that off and washing the eggs again, and keeping them in motion, the better results we have. In fact we have hardened them in sample tubs, then placed them in marked jars, and hatched over 90 per cent. Only one female was used, a medium sized fish, and the eggs would be all like shot, never stuck together, no fungus in the jar; and I think it would pay each state to give more attention to that particular point. But it will require more work and more men.

It will pay in the long run to give attention to the eggs in the washing, and the corn starch, so that they wont stick together, and harden them in tubs. We find careful attention paid to the eggs in the first place pays in the long run.

Mr. Meehan: What temperature did you have when you got 90 per cent?

Mr. Fullerton: Fifty-two degrees. This was only in the samples of the tubs that we took for experimental purposes. But we took particular care of them, and kept the tubs continually washed and in motion, and when they were finally put in the jar they were like shot, and never stuck together.

Mr. Clark: In the case of the eggs taken on the St. Clair river where it showed 70 per cent, there was no corn starch used whatever. In fact nothing was used.

Mr. Fullerton: I don't see how you got along.

Mr. Meehan: Nothing but the water?

Mr. Clark: Yes.

Mr. Downing: Along the lines of temperature I asked Mr. Buller, who had charge of the Erie station, to whom the eggs were shipped, and he hatched 80 per cent as against my 56 per cent, in regard to the water temperature, that is, about his water supply; and he said it was pumped about two and one-half miles to a reservoir, then let through pipes to the hatchery another two miles, and his water temperature was constant. But I believe that after segmentation has commenced and they are in the most tender stage, if the water temperature drops very low, it is very detrimental, if not fatal, to the eggs.

Mr. Clark: This is a vital subject. Speaking of handling the eggs as Mr. Fullerton does, I differ with him. I think the less they are handled and have them clean, the better. If the eggs could be taken and properly washed and hardened, without any stirring whatever to keep them free, it would be all the better, and I think Mr. Downing will agree with me.

Mr. Fullerton: You cannot do it.

Mr. Clark: I have a notion that the Saginaw Bay eggs were

perhaps hurt more in handling than in any other way. The St. Clair eggs not being handled so much, because the water was clearer, gave better results.

Mr. Fullerton: How can you handle the eggs without putting something on to take the stickiness off?

Mr. Clark: I think Mr. Downing will agree with me that millions of eggs have been hatched without the aid of anything further than water.

Mr. Downing: We bought eggs this year and paid for them by the quart; and they were taken by a man whom I have never seen, but he is one of the foremen for the firm that we bought our eggs from, and he did not use starch or anything, and on an average from beginning to end his eggs were the best that we had.

Mr. Fullerton: I am here to learn, but I am telling you the results that we have had.

Mr. Downing: There has been only one year before in my five years' work, while I have been in charge, that I have used anything.

Mr. Clark: I would like to ask Mr. Downing why he used starch this year, and if it was used on all the eggs?

Mr. Downing: The men that I sent out myself, I gave instruction to use starch on all of them.

Q. Why?

A. Because I was of the opinion that it was a good thing if properly used, and I impressed it on them to use it as nearly as possible according to orders, as the circumstances would allow.

Mr. Clark: Did you have any better results than you did the years you did not use starch?

A. I got one per cent better this year, but I am not certain whether it is due to the starch or the water.

Mr. Lydell: I would like to say a word in regard to the starch matter. I have had a lot of experience in securing wall-

eyed pike eggs for the Michigan Fish Commission. The reason we used the starch was, that Professor Reighard had demonstrated that the stirring of the eggs broke the yolk sac, and killed the eggs. We would take a female and strip her on the beach and fertilize the eggs, and in some cases 100 per cent were fertilized, but by putting them into a pail and stirring them he would examine them, and say there are only 30 per cent good; and the yolk sac burst in the shell. The last season I was on this work at Toledo I used the starch method to get rid of stirring the eggs; and the eggs were not stirred a particle. The method we used was nearly the same as Mr. Downing used, and we had about the same apparatus. The man had a big keg with a screen near the top, and a pail that would go into the keg and empty; then he had a small wooden chopping bowl that set on this pail, and his instructions from me were to take not more than one large or two small females, and give them plenty of milt and a little water, and they were tipped over into the pail. This pail had probably four or five inches of water. After repeating three or four times we lowered the pail into the keg, where we had put three or four gallons of water with a pound of starch; and these eggs were not disturbed at all after being put into the keg; they were simply dumped in. When he came to the end of the pound net string he turned the water on, as Mr. Downing did, inside the keg, and it ran out through the screen, and the starch washed off; he did this until we got there. Then the eggs in this keg were hustled on board the steamer and two of us took care of them until we got to Toledo. We had twelve men taking eggs. As quick as we got them on board the steamer we turned the hose on the eggs gently, played on one keg awhile and then another, until we got to Toledo; and no man's hand touched the eggs. When we got to Toledo we had an apparatus somewhat similar to the apparatus on these fish cars here, with the exception that water ran in, instead of air, and this was connected to each keg, and the water was turned on; then we went away to our dinner. When we got ready to ship they were taken from there and put in cans or boxes. In the first lot the first year that I was there we found a great many dead eggs, that we thought were injured by sudden jarrings. After that we used a spring wagon with plenty of straw in the bottom. The eggs were put aboard cars,

shipped to Detroit and handled in the same way, to the hatchery, and Mr. Bower will tell you the kind of eggs we got there. The last year I do not think there was ever a finer lot of eggs taken. We used the starch method to prevent stirring the egg.

Mr. Seymour Bower: I was in charge of the Detroit hatchery at that time, and personally supervised the handling of eggs after their receipt at the hatchery, and they were the finest lot of pike-perch eggs for a large lot that I ever saw anywhere. We had something over 70,000,000 eyed eggs from them; and the actual percentage of fish hatched was 56; they were carefully measured when received and carefully measured after being thoroughly cleaned up, and I know that the hatching percentage is accurate. They were handled in the jars substantially as Mr. Downing states.

I recall one lot in particular that we eyed, which was a little better, being 75 or 76 per cent.

Mr. Lydell: I also took eggs for a number of years on Saginaw Bay, but we could not get many of them fertilized. Mr. Marks and Professor Reighard were there for several seasons.

Mr. Clark: I would like to ask Mr. Lydell if Professor Reighard was at Saginaw Bay and made examination as to the fertilization of eggs?

Mr. Lydell: Yes, sir, two seasons.

Mr. Clark: That might solve the problem as to whether or not we are getting fertilized eggs in Saginaw Bay.

Mr. Lydell: I would bring a lot of live fish and fertilize them on the beach, and he would put them under his glasses and say, for instance, we had 90 per cent fertilized, but when we got them to the hatchery we could not hatch out more than 25 per cent, but the method used in taking the eggs was not the same as when I took charge of the work below.

The pike-perch, as you know, is very tender. If it comes in contact with anything it will burst the yolk sac; but we had orders at that time to take them that way, and the poor eggs shipped down from Saginaw Bay would fill this room.

Mr. Whish: Some of our men who have been looking into

this have noticed that there are certain seasons when the eggs do not turn out well, and they figure that it is the season following an unusually severe winter.

Mr. Clark: That would not explain why during the same year we get a hatch of 70 per cent from eggs taken from the St. Clair river, and 10 per cent from eggs taken from Saginaw Bay.

Mr. Whish: When they had an unusually severe winter on Oneida Lake, 50 per cent hatched; last year when it was warmer they got 90 per cent.

Mr. Fullerton: I would like to ask Mr. Lydell if his idea in using the corn starch was because he did not want to stir the eggs?

Mr. Lydell: Yes.

Mr. Fullerton: You say you pour the corn starch into the pail?

Mr. Lydell: We put corn starch in the keg with plenty of water, and when the eggs settled the corn starch settled with them, and got between the eggs, and kept them from adhering.

Mr. Fullerton: There is nothing in the world worse than corn starch to settle at the bottom and get into a hard cake; and it is worse than sand. It is like white lead after white lead settles, and I do not see how you can use it except you keep it stirred all the time and wash it off.

Mr. Lydell: Undoubtedly you use too much corn starch.

Mr. Fullerton: We use a pound package to a gallon of water, stir it thoroughly and put it in a tub holding about thirty gallons. We dip it out with a dipper. We never allow any one's hand to touch the eggs. The water is poured in with a dipper.

Mr. Seymour Bowers: I am strongly inclined to think that temperature has a great deal to do with the quality of the eggs. A peculiar thing about the spawning season in Saginaw Bay is, that during the season we operated there we found that we would get mature fish just as soon as the ice went out, while the water was pretty close to a freezing temperature.

Mr. Clark: The temperature was 35 degrees to 39 degrees.

Mr. Bower: And in the St. Clair river they did not begin to spawn until over a month later. I have known pike-perch eggs to be taken there as late as the 5th or 7th of June. They are all through spawning by the 5th of May in Saginaw Bay. We always get a very much higher percentage of fertilization in St. Clair river than in Saginaw Bay or anywhere else, as far as I know.

In regard to the effect of low temperature on eggs, I remember in 1893 we were conducting experiments as to retarding the development of eggs so as to make a shipment, if possible, for the World's Fair in Chicago. We lowered the temperature with ice, and while I am not absolutely certain as to the temperature, but my memory is that we reduced it to 38 degrees. I am speaking now of the green eggs; and it was fatal to nearly all of them. They did not survive a temperature of 38 degrees. We made a number of experiments and found that we could not successfully retard them; and I do not believe you can successfully retard the development of any fish eggs very much below the normal. I think it is very injurious at least to have the development of the eggs arrested. I believe that is one of the causes of the poor eggs that were taken under Mr. Clark's supervision last spring. I was at the hatchery frequently when the eggs were received, when different lots of eggs came in while the water temperature was 45 degrees, later falling to 39 degrees, and hovering about there for several days. I do not believe when the development has started that it can be arrested for any length of time without more or less injury. It must go forward at a greater or less rate, and when you arrest the development or check it entirely, as must have been the case, or nearly so at least, when the temperature dropped from 45 to 39 degrees, I believe it killed a good share of the eggs.

Mr. Lydell: What percentage did Mr. Fullerton get in his hatching?

Mr. Fullerton: We had 90 per cent hatched in the sample, roughly. We had 49 per cent in the general hatching.

Mr. Lydell: That is a big percentage.

Mr. Clark: Were not those eggs from one fish?

Mr. Fullerton: No, they were from three fish. One was a good sized fish and the other two small.

Mr. Lydell: A man can select one or two females and males and perhaps hatch 95 per cent of a quart of eggs; but in taking a big lot of eggs, the biggest I ever had was on the St. Clair river, which was 75 per cent.

Mr. Clark: I am of the opinion that in special cases, with special fish or something of the kind, it is possible to do what Mr. Fullerton has done, and perhaps it might be raised to 100 per cent.

I do not think that the attention is what gave Mr. Fullerton 95 per cent. It was a special lot of special fish sorted out for that purpose.

Mr. Fullerton: I will make an experiment on a larger scale, and I think the results will be the same with the same care.

Mr. Downing: Almost every year I have a few individual jars that turn out anywhere from 50 to 80 or 85 per cent, and they are of good quality; and I cannot account for it except that it happens so.

REMARKS ON SPONGE CULTIVATION.

BY DR. H. M. SMITH.

Perhaps you are not averse to turning your attention for a moment from fishes to the long suffering and humble sponge. All the gentlemen present may not be aware that for a number of years we have been growing sponges from clippings at several farms on the Florida coast. Those who care to pursue the subject further are referred to the paper by Dr. H. F. Moore on "Progress of Experiments in Sponge Culture" which appeared in the proceedings of the society for last year (page 231). Dr. Moore has been in charge of those experiments and I want to exhibit some specimens which he brought up from the farm near Anclote Key, on the west coast of Florida this spring.

The sponges are grown, as I have said, from cuttings, the cuttings being about a cubic inch in volume; and the advantage of this method is that irregular sponges having little market value, can be planted and will grow into perfectly symmetrical sponges of better quality than wild sponges grown on the same ground, for reasons that have been explained before.

I exhibit a string of sponges three years old, having a value today of \$3.50 a pound. If left on the ground another year they would be worth \$4.50 to \$5.00 per pound, about twelve sponges to the pound. Gentlemen who are interested are requested to feel these sponges, more especially the moist ones, and see what excellent quality they represent.

DISCUSSION.

Mr. Clark: I would like to ask Dr. Smith a question: Do sponges of any form grow in fresh water?

Dr. Smith: Yes, sir, but they are of no commercial value, only as biological curiosities.

Mr. Clark: There was brought into my office this spring a small piece of sponge, as I called it, taken off the stones in a bass pond.

Dr. Smith: They are usually of very small size.

FROG CULTURE.

BY W. E. MEEHAN, COMMISSIONER OF FISHERIES.

In May, 1904, a four-line item sent out by the Associated Press appeared in the Pennsylvania newspapers, announcing that the Department of Fisheries would receive applications for frogs or tadpoles for public planting. In anticipation of this announcement the Department of Fisheries had prepared about 1,000 blank application forms. To the astonishment of the Department the 1,000 blank application forms were taken up within ten days and it is safe to say that nearly 1,000 letters in addition were received, asking to be supplied with frogs for stocking purposes. Editorials appeared in the majority of the country papers and even in the metropolitan daily papers calling attention to what they termed an admirable effort on the part of the Department of Fisheries to rear frogs. To my surprise and pleasure hundreds of letters poured in commending this branch of the work and before long the news of Pennsylvania going into the work of frog culture extended beyond the state and letters of inquiry came from many state fish commissioners and from magazines devoted to fish cultural work.

I had always regarded it as important that frog culture should be undertaken because I saw that an important industry could be developed. Almost immediately upon assuming my duties as Commissioner of Fisheries I directed the various superintendents to experiment with a view of successfully raising frogs. My wishes in this particular were well known not only in Pennsylvania, but elsewhere, consequently when the public announcement was made that applications for frogs would be received and filled it was naturally supposed that success had followed the experiments. This, however, was not the fact, although one of the superintendents, Mr. William Buller of the Corry Hatchery, was on the eve of what now appears to be a complete success. The tadpoles and young frogs distributed in 1904 under the calls were raised from wild spawn, gathered in the marshes on Lake Erie by Mr. A. G. Buller, superintendent of the Erie Hatchery.

The work of Mr. A. G. Buller nevertheless was exceedingly interesting. The spawn was in various stages of development, from green to nearly hatching. Indeed much of the spawn was so far advanced that hatching took place on the way from the marsh to the hatchery ponds at Erie.

The eggs were placed in a small pond, the water of which was from 57 to 60 degrees and the period of complete incubation was in about twelve days.

Almost immediately on hatching the little creatures clung closely to the gelatinous mass from which they emerged and began to eat it and they never left until it was entirely gone. Then they spread over the pond hunting for food. There were rather more than 30,000. They soon cleaned up every particle of food which was in the pond and Mr. A. G. Buller then supplied them with dead fish, and so great was their voracity that they easily devoured from 16 to 25 pounds of fish a week. On one occasion they completely stripped a 16-pound carp in four days.

The temperature of the water rose a little above 60 degrees and in this the tadpoles grew very fast and in about two and one-half months from the date of their hatching began to develop their hind legs. Three weeks later they broke forth their fore legs and the outline of the body and head began changing to that of a frog. The tail also began to be "absorbed." The moment the hind legs appeared and before the tail was absorbed and before the body completely changed to frog outlines the creature ceased to feed on dead food. For a few days they seemed to refuse any kind of food, but before the tail was half absorbed they began to take live creatures only. They confined themselves almost exclusively to insects and spiders. As illustrating the extreme voracity of tadpoles and the eagerness with which they would take dead food was markedly shown on one occasion at the Wayne County Hatchery this spring. A black-bass weighing about four pounds and extremely malodorous, having been dead several days, was thrown into a portion of the pond in which for the moment there were no tadpoles. Within two minutes at least 200 tadpoles nearest to the fish, began a number of curious evolutions. They rolled and tumbled over each other in thick masses until they formed almost a ball and

in this manner they rolled and tumbled and swayed rapidly toward the dead fish on which they fastened themselves at once. The tadpoles even at the extreme end of the pond some twenty feet away seemed to be cognizant of the presence of the food, and large numbers of them made their way in the same strange evolutions to the tidbit and settled themselves so thickly thereon that within five minutes it was impossible to see anything but a mass of tadpoles outlined like a fish. They stripped every particle of flesh from the dead bass within an hour.

Returning to the tadpoles hatched in 1904, by the first of August there was not one in the Erie ponds, but had changed entirely into a perfect frog. Shipping began in July. Three hundred and fifty were sent on each application and they were sent in tadpole form with the cans about half filled with water. The first shipment of tadpoles having legs were made in the same manner, namely in water, but it was found that they did not carry well, and the frogs, it was learned, carried best when placed in damp glass. It was unnecessary to send any messenger along with either the tadpoles or frogs, excepting where more than one railroad transfer had to be made. Nothing could be done as far as known, to benefit them by sending messengers, and no aeration is necessary because the higher the temperature the better the tadpoles would probably like it.

This year two ponds at the Erie hatchery were set aside for hatching wild spawn and about 60,000 were hatched in each pond. Owing to weather conditions the water was much colder than last year and the hatching period was from 15 to 18 days. The tadpoles were much smaller than those hatched last year, probably on account of the cold water. They appeared, however, to be as healthy and active. They remained in this condition for about five weeks, when suddenly the tadpoles in one of the ponds sickened and died. Thirty thousand died in one night. The rest were hurriedly planted in the marshes at Erie the following day, some dying on the way. The tadpoles in the other ponds remained apparently all right for about ten days, when they too died, the whole pond becoming empty of live tadpoles within thirty-six hours. An examination showed that on the stomachs of each tadpole was a round red spot. Unfortunately no microscopic examination was made and no specimens were

sent to my office for examination owing to my absence from Harrisburg. The tadpoles at the Wayne Hatchery, several hundred thousand in number, showed no signs of disease and are now being shipped to applicants.

The experimental work in frog culture at the Corry Hatchery was exceedingly interesting. Mr. William Buller constructed a little pond which he concluded the frogs would naturally take to. Two hundred large frogs were brought from Lake Erie and placed therein. Within twenty-four hours they had all climbed the fence which surrounded the pond and departed to a nearby woods where they have since increased and multiplied marvelously. Last year he remodeled the pond, changing the form of the fence in such a manner that the frogs could not escape. More than 200 large frogs were placed within the inclosure and all lived through the winter and spawned this spring. They yielded about 10,000 tadpoles and at the time of writing this paper they are still within the inclosure and apparently perfectly healthy and contented. As it is well known that frogs will eat nothing but live food the real problem was to supply a large number in a small space and this was done by placing boards both on the wet grass outside the water limit and by anchoring others on the surface of the pond. On these boards were smeared molasses and honey. Bees and other insects were attracted in large quantities and the frogs fattened. The same method of feeding is now pursued. Both old and young frogs and tadpoles refuse maggots.

The pond proper is about 20 feet long with a deep bottom of soft muck. During the winter months at the breast of the pond the water was about four feet deep and kept so until winter passed entirely away, when the supply of water was reduced to about a foot at the breast and only a few inches at the upper end. The bed of the pond sloped upward from the breast until only there was about a few inches from the foot of the mucky bed to the surface of the ground and this was occasionally flooded with water and the grass allowed to grow, grass being not only hiding places for the frogs, but also serving to attract insects. The fence was placed about four feet from the edge of the pond. Fitting close to the ground was placed a 12-inch board on edge on all four sides of the pond and a 30-inch mosquito bar was

tacked on the inner side of the board so that there was a fence 42 inches high. Posts were placed every six feet. On the top of the fence was carefully fastened a piece of muslin 12 inches wide and extending at right angles with the fence. It was found necessary to place this muslin there because otherwise the frogs would clamber up the wire screen and escape over the top, but by tacking the muslin on they found a space or ceiling which balked them. Great care must be exercised that the muslin fits tight to the top of the fence, otherwise the frogs will raise the muslin and escape under it, just as a boy would crawl under a canvass of a circus tent. In fact, at Lake Erie, although the superintendent thought he had everything secure more than 200 managed to escape in one night by creeping under the muslin. These escaping frogs by the way invaded the neighboring yards and houses to the discomfort and alarm of the feminine occupants. At the Torresdale Hatchery a 12-inch planed board is substituted for the muslin and gives greater satisfaction.

In caring for frogs, especially in the tadpole stage it is necessary to guard very carefully against the ravages of snakes. These reptiles before they were discovered devoured fully 100,000 tadpoles at the Corry Hatchery and accomplished this feat in less than three weeks. I have given above the results of Pennsylvania's work thus far in frog culture. It has reason to be encouraged in the belief as a result it has demonstrated that a large number of frogs can be cared for in a very limited space and that with ordinary precaution and the expenditure of individual energy a very large and valuable industry can be built up in the United States.

DISCUSSION.

At the conclusion of his paper Mr. Meehan said: "There are one or two things that I would like to add which have occurred since the writing of this paper some six or seven weeks ago. I have stated in here that apparently the snakes were the cause of the loss of all frogs in the Corry hatchery. While that may still be the case to a considerable extent, I have reason to believe that there was another cause, and perhaps one that was even of more importance than the snakes, and that is the frogs themselves. Now since writing this paper Mr. Nathan R. Buller, the

superintendent of the Wayne County hatchery, discovered that the frogs were very fond of the tadpoles and devoured them very eagerly; so it is quite possible that the frogs themselves were partly responsible for this destruction of many of the frogs in Corry pond. It therefore follows that when we carry on frog culture it will be necessary to have an additional pond to the one in which the frogs are kept; that either the spawn must be taken out and hatched elsewhere, or the tadpoles and the frogs must be separated.

We find also some other enemies among birds. Not only the ordinary predatory birds, but the crows have developed great fondness for tadpoles, and Mr. Buller had quite a time with them for several days, until he managed to keep them off by scare-crows.

It is needless to say that, considering the general excitement in regard to putting forth frogs by Pennsylvania, and in ending what I have got to say here, perhaps it might not be uninteresting to read you a short clipping coming from a little paper in Hanover, Pennsylvania, which shows that even we ourselves who hatch fish and frogs do not know everything. This little item is entitled, "Pretty Little Frogs," and is as follows:

FOUR THOUSAND HOPPERS RECEIVED BY HANOVER PARTIES.

Messrs. S. W. Yingling, of Hotel Hanover, and H. M. Stokes, of York St., have received from the State Fish Hatchery at Pleasant Mount, Wayne County, a consignment of 2000 young bullfrogs, in two cans, each can containing 1000 frogs. Two additional cans were received by parties residing in the country near Hanover.

The frogs are sent out by the State Fish Commission for propagation in the streams of this vicinity. Mr. Yingling took his brood to Waldheim Wednesday, and released them in the Conewago Creek.

The bullfrogs in this shipment are of a different species from that known in this section. Each frog is about one-fourth of an inch long, and perfectly formed like a full-grown frog, only much smaller. They are of French origin, and do not pass through the tadpole or "mullygrub" evolution. They are dainty little creatures in their present state, but appear lively and are ready to hop or swim whenever given a chance.

Dr. Gorham: In regard to the disease which Mr. Meehan spoke of as killing so many of his frogs, it is undoubtedly a very well-known disease which occurs among frogs whenever considerable numbers are kept in confinement. I have had cases of that disease among frogs that I have kept for some time. I might say also, that a very careful study of the disease, from all standpoints, has been made and published within the past year, by Mr. H. Emerson and Mr. Charles Norris, in the *Journal of Experimental Medicine*, New York, 1905, VII, 32, the subject of the article being "Red-leg," an Infectious Disease of Frogs." The article is a complete one, and describes the disease very carefully, and suggests remedies and methods of prevention.

Mr. Meehan: Can you recall one of those remedies?

A. I don't remember the remedies.

Q. Is it an infusorial trouble?

A. A bacterial disease.

Mr. Titcomb: In what stage of development do you make your distribution?

Mr. Meehan: At first we distributed in tadpole form, but we abandoned that and we now distribute in frog form only. The tail may still be there, but the legs may also be present and the frogs have abandoned the water altogether, and use only the wet moss.

In shipping, I ought to add, that it is very necessary if you use the cans the same as we do, that is, with a single round hole in the top, to put over the top of the can a piece of mosquito netting, or the frogs will crawl out.

Mr. Nathan R. Buller: All of the reports have been very favorable in regard to the successful shipment of frogs.

Mr. Dinsmore: I remember reading some years ago quite a lengthy description on frog culture, in which the conclusion reached was, that there was no trouble in rearing the tadpoles in unlimited numbers, but you could not supply food for the frogs. Now why can you not supply the frogs with the superfluous number of tadpoles, if, as the writer says, you can get the tadpoles in unlimited numbers?

Mr. Meehan: I have not had an opportunity to talk with Mr. Buller much about that. He reported to me that he found frogs eating the tadpoles. He can tell you to what extent they did it.

Mr. Densmore: Do you use any particular species of frogs?

Mr. N. R. Buller: At Erie we use the great western frog, the large frog; at Wayne the green frog; at Corry the western frog altogether.

Mr. Dinsmore: What was the actual size of the frogs that you shipped?

Mr. Buller: About an inch and a half long.

Mr. Lydell: At what time does the tadpole shed his tail? I have collected large tadpoles to feed as food to the bass. They are just now commencing to form legs. We have seined them up there in ten or fifteen quart pails full, to feed the bass. I took it for granted that these frogs were from the spawn of the frog last year, because the big green bullfrogs are now spawning.

Mr. Meehan: Apparently there are two periods of spawning. We have frogs spawning early in the season and they are spawning again. We find them preparing to spawn in the Wayne ponds.

The period of changing from tadpole to frog form will vary considerably according to the temperature of the water. It is a curious fact that several years ago, five or six, or perhaps more, Mr. William Buller raised a large number of tadpoles at Corry; and he carried them through to this spring in tadpole form, and they were in spring water at a temperature of 50 degrees. They retained the tadpole form throughout the winter and did not change to the frog form until the spring, that is, until one year had elapsed. On the other hand we have hatched them out and in about thirty days we have the full tadpole of the same species.

Mr. Lydell: Then I think ours the two-year variety.

Mr. Meehan: These frogs you see here were this spring's spawning.

Dr. Gorham: In New England all our frogs have one spawning season.

LIST OF MEMBERS.

ACTIVE.

- Adams, E. W., *114 Wall Street, New York.*
Adams, Fred J., *Grand Rapids, Mich.*
Ainsworth, C. E., *Sault St. Marie, Mich.*
Ainsworth, G. G., *United States Bureau of Fisheries, Leadville, Col.*
Allen, A. D., *Superintendent Wallowa Hatchery, Elgin, Ore.*
Allen, G. R., *Roxbury, Vt.*
Alexander, A. B., *United States Bureau of Fisheries, Washington, D. C.*
Alexander, George L., *Grayling, Mich.*
Alexander, L. D., *50 Broadway, New York.*
Anderson, J. F., *Djursholm, Sweden.*
American Fish Culture Co., *Carolina, R. I.*
Andrews, Barsehall, *Columbus, Ga.*
Annin, James, Jr., *Caledonia, N. Y.*
Ashford, W. T., *711 Prudential Building, Atlanta, Ga.*
Atkins, Charles G., *East Orland, Me.*
Atwood, Anthony, *73 Waterrest Street, Plymouth, Mass.*
Ayer, F. W., *Bangor, Me.*
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Weed, W. R., *Potsdam, N. Y.*
Wetherbee, W. C., *Port Henry, N. Y.*
Wheeler, Charles Stetson, *Hobart Building, San Francisco, Cal.*
Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*
White, R. Tyson, *320 Bridge Street, Brooklyn, N. Y.*
Whiting, Caspar, *239 Fifth Avenue, New York City.*
Whitaker, Hon. Andrew R., *Phoenixville, Pa.*
Wilbur, H. O., *235 Third Street, Philadelphia, Pa.*
Wilbur, P. H., *Little Compton, R. I.*
Willard, Charles W., *Westerly, R. I.*
Willetts, J. C., *27 Pine Street, New York City.*
Williams, J. A., *Burlington, Vt.*
Wilson, C. H., *Glen Falls, N. Y.*

- Wilson, S. H., *Cleveland, O.*
 Winn, Dennis, *United States Bureau of Fisheries, Washington, D. C.*
 Winn, S., *Carolina, R. I.*
 Wires, S. P., *Lester Park, Duluth, Minn.*
 Wisner, J. Nelson, Jr., *United States Bureau of Fisheries, Oregon City, Ore.*
 Wolf, Herman T., *489 The Bourse, Philadelphia, Pa.*
 Wolters, Charles W., Dr., *Philadelphia, Pa.*
 Wood, C. C., *Plymouth, Mass.*
 Wood, Frank, *Edenton, N. C.*
 Worth, S. G., *Beaufort, N. C.*
 Wride, George A., *Grindstone City, Mich.*
 Zacharie, Col. F. C., *345 Corondelet Street, New Orleans, La.*
 Zweighapt, S., *Deer Park, Haines Falls, N. Y.*

HONORARY.

- Borodine, Nicholas, *Chief Specialist in Fish Culture, Department of Agriculture, St. Petersburg, Russia.*
 Cortelyou, Hon. George B., *Washington, D. C.*
 Denbigh, Lord, *Colonel of the Honorable Artillery Company, London, England.*
 Fish Protective Association of Eastern Pennsylvania, *1020 Arch Street, Philadelphia, Pa.*
 Fryer, Charles E., *Supervising Inspector of Fisheries, Board of Agriculture and Fisheries, 3 Delahay St., London, England.*
 Hamilton, Dr. J. Lawrence, *M. R. C. S., 30 Sussex Square, Brighton, England.*
 Hofer, Prof. Dr. Bruno, *Munich, Germany.*
 Kishinouye, Dr. K., *Imperial Fisheries Bureau, Tokyo, Japan.*
 Lake St. Clair Shooting and Fishing Club, *Detroit, Mich.*
 Mrs. Frank M. Johnson, *Boston, Mass.*
 Matsubara, Prof. S., *President Imperial Fisheries Institute, Tokyo, Japan.*
 Metcalf, Victor H., *Secretary of the Department of Commerce and Labor, Washington, D. C.*
 New York Association for the Protection of Fish and Game, *New York City.*

Peek, Hon. George W., *Milwaukee, Wis.*
 South Side Sportsmen's Club, *Oakdale, L. I., N. Y.*
 The President of the United States.
 The Governors of the Several States.
 Woodmount Rod and Gun Club, *Washington, D. C.*

CORRESPONDING.

Ayson, Lake F., *Wellington, New Zealand.*
 Ayson, Charles L., *Hakataemen, Oamaru, New Zealand.*
 Apostolides, Prof. Nicolý Chr., *Athens, Greece.*
 Armistead, J. J., *Dumfries, Scotland.*
 Birbeck, Edward, Esq., *M. P., London, England.*
 Brady, Thomas 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.*
 Jaffe, S., *Osnabruck, Germany.*
 Landmark, A., *Inspector of Norwegian Fresh Water Fisheries, Christiana, Norway.*
 Maceleay, 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., *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	437
Honorary	61
Corresponding	19
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Total membership.....	517

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

Any person shall, upon a two-thirds vote, and the payment of \$25, 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.

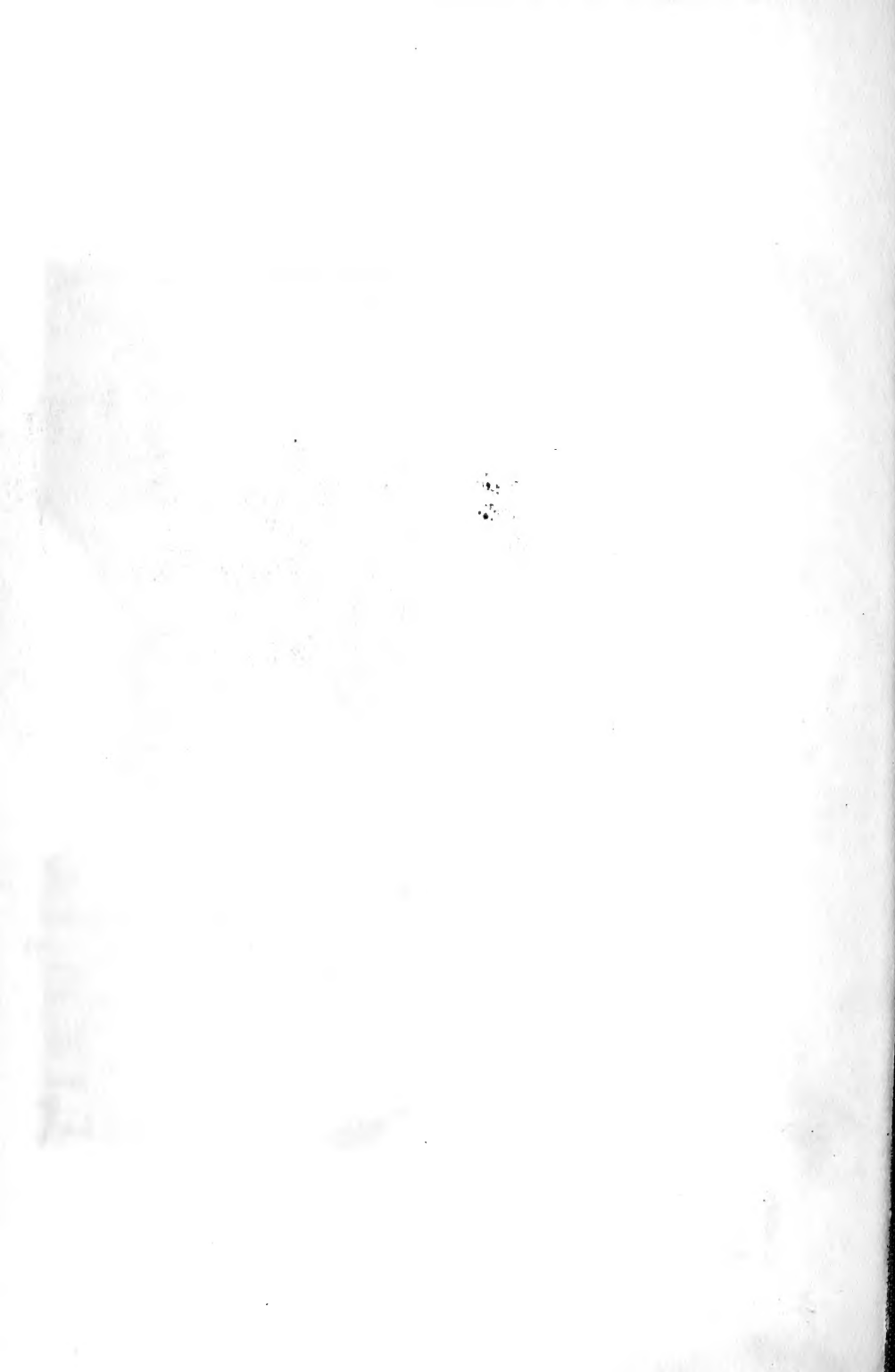
(Note—
 - a. In the reading of papers preference shall be given to members present.
 - b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society.))
7. Miscellaneous business.
8. Adjournment.

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.





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American Fisheries
Society
Transactions

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