TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED FOUR

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.

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Vice-President.....C. D. JOSLIN, Detroit, Mich.
Recording Secretary.....GEORGE F. PEABODY, Appleton, Wis.
Corresponding Secretary, CHARLES G. ATKINS, East Orland, Me.
Treasurer.....C. W. WILLARD, Westerly, R. I.

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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 Asso., 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. Titcomb: 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. Titcomb: 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.

Motion seconded and carried.

The chair appointed Mr. Boardman of Rhode Island, Mr. Evans of Pennslyvania, Mr. Carter of Vermont, as members of the committee on resolutions.

The secretary then submitted the following correspondence to the society:

Washington, D. C., June 4, 1904.

Mr. George F. Peabody, Appleton, Wisconsin:

Dear Mr. Peabody:—I beg to acknowledge the receipt of your letter of the first with reference to the meeting of the American Fisheries Society at Atlantic City on the 26th, 27th and 28th. Nothing would give me greater pleasure than to read a paper as described, but I am afraid that even if this subject had not been thrashed threadbare by the newspapers and magazines, I would not have the time to do so. I have already prepared and have published in the souvenir guide of the Government Board, a very complete description of the exhibit and its objects, so that I am afraid that I should simply have to read what the members of the society have seen in half a dozen places already.

Do not put me down for the paper, but if I can attend and have the time I shall be very glad to help you out. I am sending you under separate cover a copy of the guide referred to.

Am very anxious to attend the meeting at Atlantic City, as I enjoy the meetings greatly, but my position here is a peculiar one. I am employed in the Smithsonian Institution and have charge of the Fish Commission exhibit at St. Louis, Missouri. Consequently, as I am obliged to be in St. Louis a certain limited extent of time I do not absent myself from this office unless it is absolutely necessary during the present year. Very sincerely,

W. De C. RAVENEL, Corresponding Secretary.

Toronto, June 6, 1904.

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

Dear Sir:—I have your letter of the 2nd, suggesting that I prepare a paper for the next meeting of the Society. I have just returned to the office after a rather severe illness of one month, and I have not much energy for anything of the kind; but I am picking up, and perhaps I will in the course of a day or two feel like writing something. In that case I will let you know. The Association meets at a period of the year when I am sojourning with my family in the

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 thec onstitution 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 threafter 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 collafed 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 i nthat 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. (Noices—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 Bueau 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 th 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 mediations, 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 deliverd 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

These notes were first embodied in a letter from Mr. Marsh to Mr. Whish and by him presented to the meeting.

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 catagory: 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: Arkanas, 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 unfailing 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 midsummer 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 near-by 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-

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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 Swantan 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, Missisquivi 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?

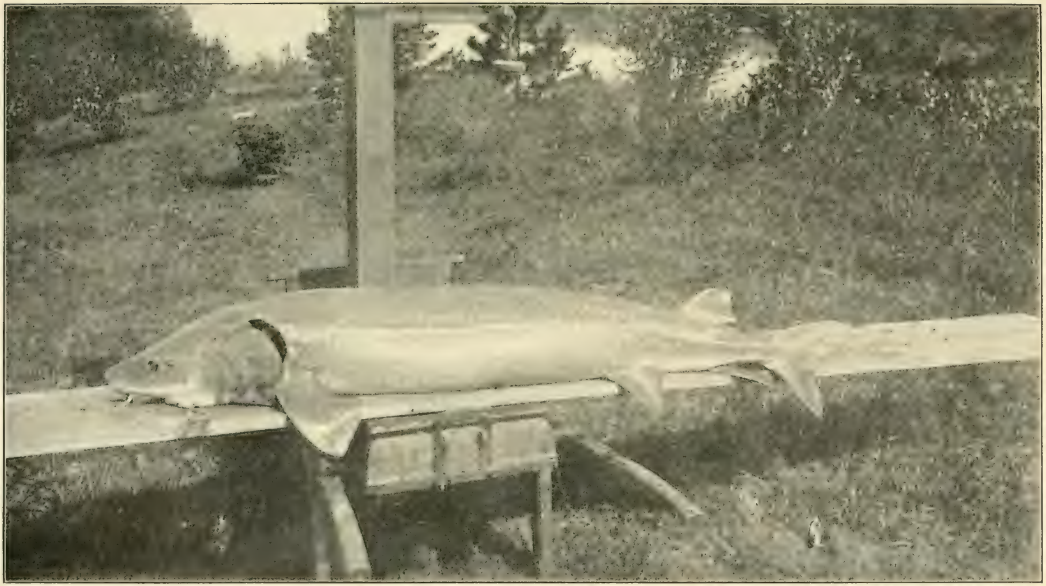
A. There was no trouble about their adhering at all—any more than there is in pike-perch eggs. The eggs should be looked after carefully from the time they are taken away until they are impregnated and water-filled.

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, mushed 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 ¾ 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 homegeneous 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.

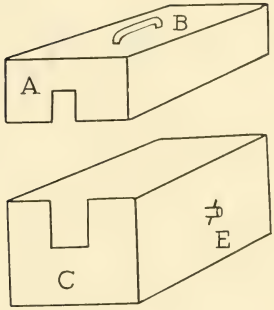
A small scoop spoon is attached to the center of the axis which is caused to revolve by means of a four-bladed water-wheel attached to the shoulder.

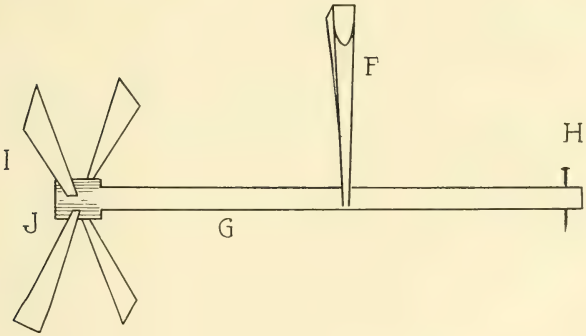
The box has a cover.

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, yellow-perch, 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 Philadephia 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 inverterate 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.

Mt. 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

merchantable 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 34¼ 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 than 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 ourself, 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.

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* 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 1½ 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, bookkeeping, 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 cuttle-fish, 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 Yokohoma, 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,

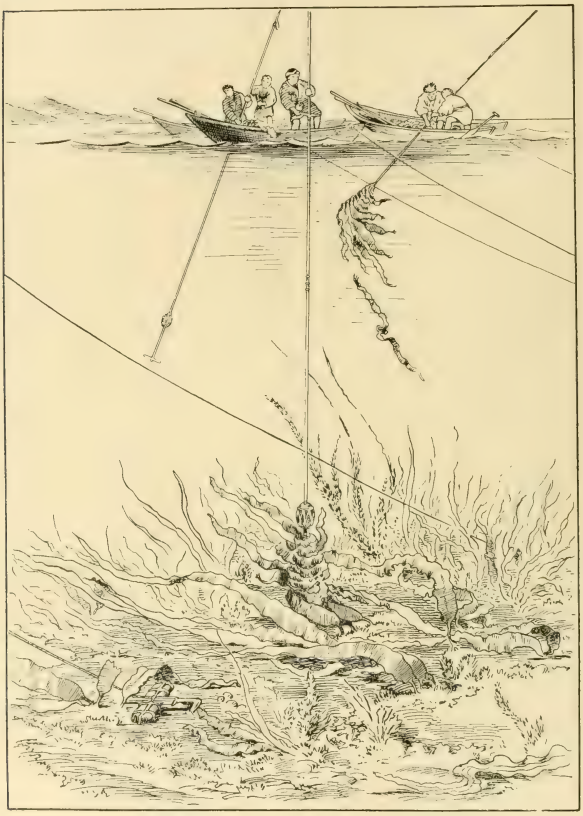
at first for the mere pleasure of the owner, but later it became a commercial enterprise and is now very profitable.

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 algæ 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



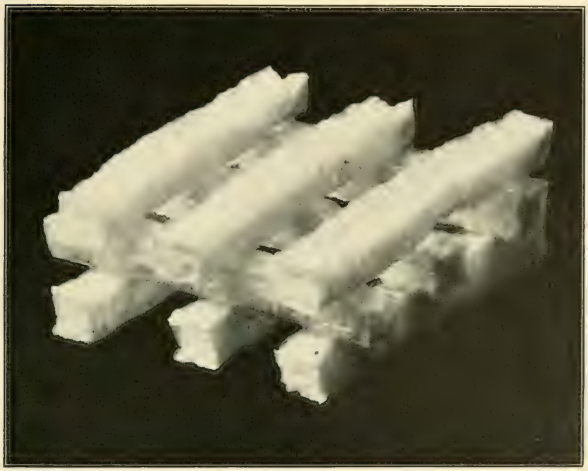
GATHERING KELP IN HOKKAIDO.

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

Various algæ 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 1½ 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 2½ 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 algæ from stones develop on the lips, and ever afterward algæ 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 employes 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.

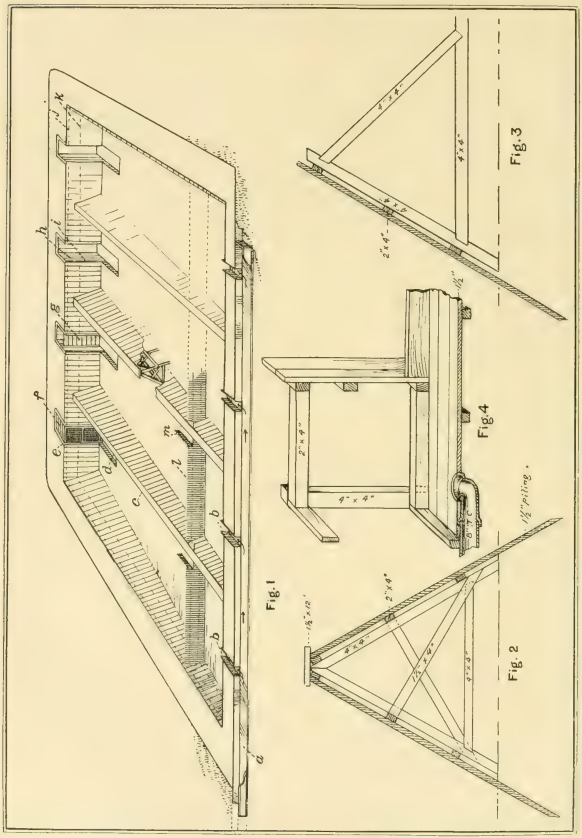
I beg to submit herewith a plan for bass ponds which combines the advantage of a large pond for breeding and small ponds to facilitate drawing and cleaning, together with a greater depth of water over the entire pond than is possible in a large pond built on the plan at present followed in this Bureau. 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

by the sub-division, on the top of which is spiked a twelve inch running board over which barrows can be run to remove the



PLAN OF SERIES OF BASS PONDS, CONVERTIBLE INTO ONE POND BY RAISING THE WATER LEVEL.

a—Supply Fume.
b—Inlet.
c—Running Board, 12 in. wide.
d—Receiver.
e—Screen.
f—Coun.
g—Dam Boards.
h—Cleats for Dam Boards.
i—Cleats for Screen.
j—High Water Mark.
k—Low Water Mark.
l—Bass Fence Made of Pickets. 2x½ in.
m—Gate.

plant or silt, should it become necessary at any time to remove the latter.

A fence built of one-half inch by two inch pickets runs the

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. Titcomb, 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-mouh 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 jealously, friction and scrapping.

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 conspicious 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 recourceful 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 hog 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 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, becasue 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 cannabalism 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 cannabalism. 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 cannabalism.

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 numerously 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 cannabalism; 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; cannabalism 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 objecton 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 asortment 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

*Letter of S. W. Downing.

appear to be gaining ground. In this category may be mentioned the horse mackerel or tunny [*Thunnus thynnus*] and the whiting or silver hake [*Merlucius 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 wofully 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 s 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 putridits 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 respulsive 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.

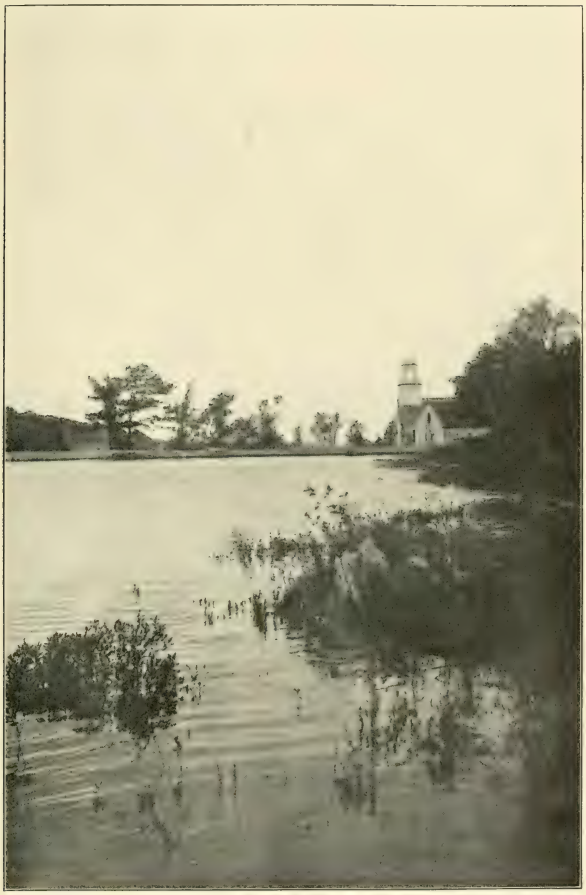
In the winter months I have not had to feed the fish at all—in fact you cannot feed anything in the waters in Springfield during those months—you can chop ice as long as you like, and that is about as near as you get to the fish—you will still be chopping in the spring. (Laughter.) They are never seen 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.

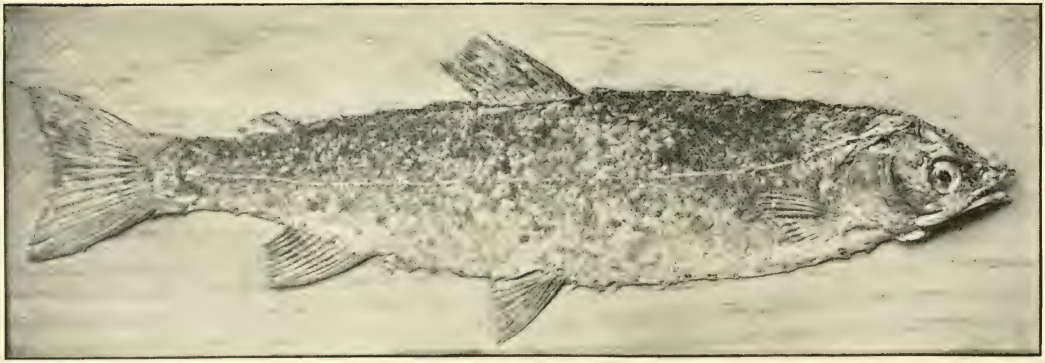
You will see on one of these photographs what fish are supposed to be in the waters. I suppose where this is marked "grayling" that the graylings are there; it is a supposition on my part because no one has ever seen them since the third day they went into the water; they have not appeared against the 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 9¾ 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 impertiment 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. Johson 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.

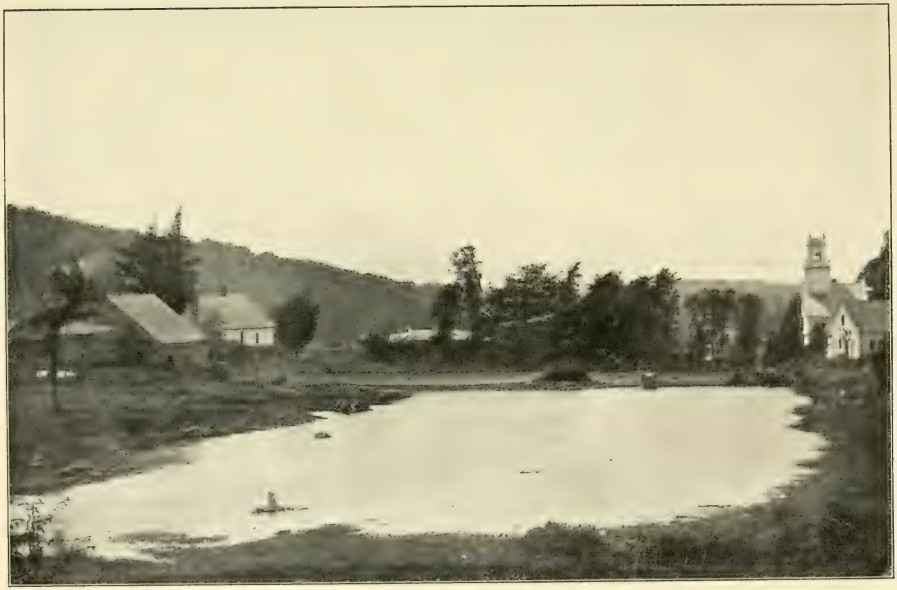
men of the ability and resources of Dr. Johnson take up this study of diseases of trout and of other fish. I got a wail from a man in the Adirondacks a short time ago. He wrote me, "Black bass diseased. What can we do?" I asked him what was the matter and he said: "The large fish have what looks like 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.

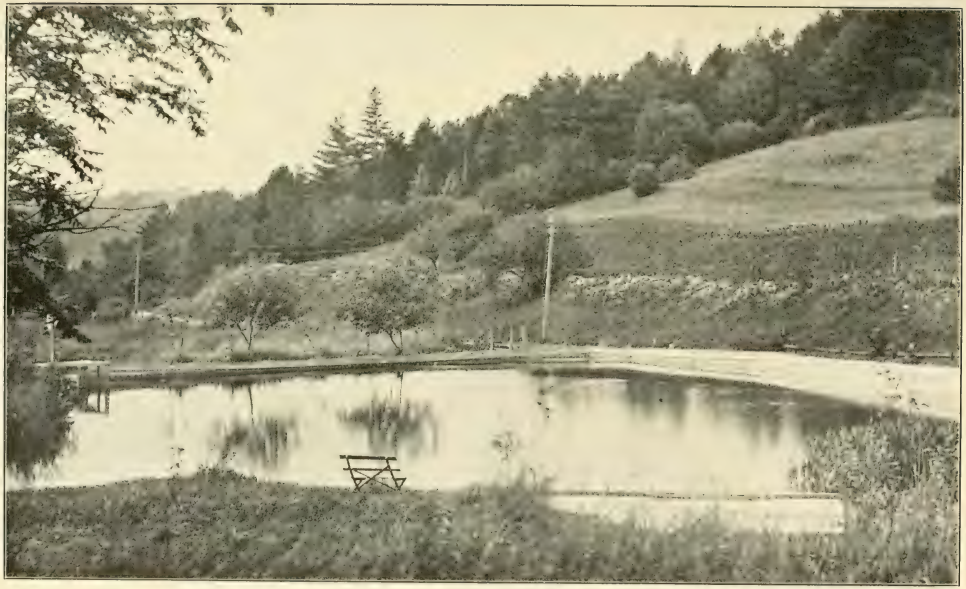
Mr. Slade: The South Side Club, as some of you know who have visited it, runs a hatchery simply for the purpose of stocking its own waters. Twenty-five years ago when the late Hon. George M. Robson was secretary of the navy, we received from him a consignment of rainbow trout eggs. These were hatched, 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 Triest. 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 artifically 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 paraffien 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 capsized 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 innoicuous 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 with 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-

perimenter 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.

Borodine, Nicholas, *Delegate 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. Nicoly 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.*

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

Jaffe, S., *Osnabruck, Germany.*

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

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

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

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

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

Olsen, O. T., *Grimsby, England.*

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

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

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

Trybom, Dr. Filip, *Stockholm, Sweden.*

RECAPITULATION.

Active	453
Honorary	61
Corresponding	22
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.

The thirty-fourth annual meeting of the American Fisheries Society will be held July 25, 26 and 27, 1905 at White Sulphur Springs, West Virginia, U. S. A.

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED FIVE

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-fourth Annual Meeting

JULY 25, 26 AND 27, 1905,

At White Sulphur Springs, West Virginia.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.
1905.

Officers for 1905-1906.

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

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.

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, whereupon 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. F., *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.*
Cruickshank, 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, Dayton, 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, Cleveland, 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.*

Talbott, 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

EXPENDITURES.

1904.		
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
		$644.57

Respectfully submitted,

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., Torrisdale 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.)

Cruickshank, 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 Protective 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.)

Keeseeker, A. G., Fishery, Tenn.

Lamprey, Judge Uri L., St. Paul, Minn. (By S. F. Fullerton.)

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. Ravanel 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. Ravanel 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 3¼ 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. Evermann 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 ¾ of an inch in length; ¾ to 1½ inches, call them No. 1; 1½ to 2½, No. 2; 2½ 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 unanimusly 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. Juel, *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	Fingerlings Yearlings and Adults	Total
Catfish	.....	.....	427,402	427,402
Buffalofish	.....	.....	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	880,000	1,000,000	.....	1,880,000
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
Pollock	.....	8,456,000	.....	8,456,000
Lobster	.....	116,214,000	.....	116,214,000
TOTALS	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 befort 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 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 developement 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 fisheulture in other ways not previously recorded. It enables one to distinguish the dead and unfertilized eggs at an early stage of developement. 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. Titcomb: 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. Titcomb: 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 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 superaeration, 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 lobstrs 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, ofter 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 furthem 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 wih 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 ben 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		
			Begins	Ends	Length Days	Ends	No. of Days		Whole Term Count	Whole Term Per ct.	Daily per 10,000
1847 A.....	Atl. Salmon.....	No food....	June 4.....	June 8.....	5	June 23.....	20	1,000	25	2.5	12
1847 B.....	Atl. Salmon.....	No food....	June 4.....	June 13.....	10	June 28.....	25	1,000	43	4.3	17
1847 C.....	Atl. Salmon.....	No food....	June 4.....	June 18.....	15	July 3.....	30	1,000	64	6.4	21
1847 D.....	Atl. Salmon.....	No food....	June 4.....	June 23.....	20	July 8.....	35	1,000	217	21.7	62
1847 E.....	Atl. Salmon.....	No food....	June 4.....	June 8.....	5	June 23.....	20	500	2	0.4	2
1847 F.....	Atl. Salmon.....	No food....	June 4.....	June 13.....	10	June 28.....	25	500	4	0.8	3.2
1847 G.....	Atl. Salmon.....	No food....	June 4.....	June 18.....	15	July 3.....	30	500	33	6.6	22
1847 H.....	Atl. Salmon.....	No food....	June 4.....	June 23.....	20	July 8.....	35	500	73	14.6	42
1847.....	Control lot	No food....	No	Fast	.....	July 8.....	35	15,010	646	4.3	12
1768 A.....	Brook trout.....	No food....	May 23.....	May 27.....	5	June 12.....	20	1,000	22	2.2	11
1768 B.....	Brook trout.....	No food....	May 23.....	May 31.....	9	June 16.....	24	1,000	60	6	25
1768 C.....	Brook trout.....	No food....	May 23.....	June 5.....	14	June 20.....	29	1,000	517	51.7	177
1768 D.....	Brook trout.....	No food....	May 23.....	June 10.....	19	June 25.....	34	1,000	776	77.6	228
1768.....	Control lot.....	No food....	No	Fast	.....	June 25.....	34	15,438	936	6.1	17.9
1747 A.....	Lake trout.....	Fed 6 days..	May 23.....	May 27.....	5	June 11.....	20	100	3	3	15
1747 B.....	Lake trout.....	Fed 6 days..	May 23.....	May 31.....	9	June 15.....	24	100	9	9	38
1747 C.....	Lake trout.....	Fed 6 days..	May 23.....	June 5.....	14	June 20.....	29	100	42	42	145
1748 D.....	Lake trout.....	Fed 6 days..	May 23.....	June 10.....	19	June 25.....	34	100	72	72	212
1832 A1.....	Silver salmon	No food....	May 18.....	May 22.....	5	June 6.....	20	500	8	1.6	8
1832 A2.....	Silver salmon	No food....	May 18.....	May 27.....	10	June 11.....	25	500	8	1.6	6.4
2832 A3.....	Silver salmon	No food....	May 18.....	May 31.....	14	June 15.....	29	500	8	1.6	5.5
1832 A4.....	Silver salmon	No food....	May 18,.....	June 5.....	19	June 20.....	34	500	6	1.2	3.5
1832 A.....	Control lot.....	No food....	No	Fast	.....	June 20.....	34	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 unfortuately 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 Adirondack hatchery supplied by Lake Clear; the Caledonia hatchery with its magnificient 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 Adirondack 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 Salmonea 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 Adirondacks. Thus far the waters of the eastern side of the Adirondacks 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 Adirondacks 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 Adirondacks 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 Adirondack 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 Salmonidæ 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 Adirondack 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 Adirondack 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 your 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. Titcomb: 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 Adirondack 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 cutthroat 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 algæ 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 algæ, and still more recently for killing typhoid. Its use for the latter purpose is very much more restricted than for the algæ. 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 Hammondsport 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 uncleanliness.

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. Talbott: 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 Sulpher 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. Titcomb, 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 serions 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 Neuguen, 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 Paraquay, 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 Limay 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 plyers 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 quinnet 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 TALBOTT 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 Mackeral 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 sunspot 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.

(Secre ary and Counsel Maryland State Game and Fish Protective Association. Assistant State Game Warden.)

Great difficulty is at once apparent, especially to you, gentlement, 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 arm 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 changd 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 nw 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 gameness, 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 sepcies 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 cutthroat 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 attemps 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

PLATE III.—Showing the appearance of one of the side floats containing the bags for raising the young lobsters. This plate shows, on the right, the universal joint by means of which the power is transmitted to the shafting of the float from the house-boat.

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 is 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-

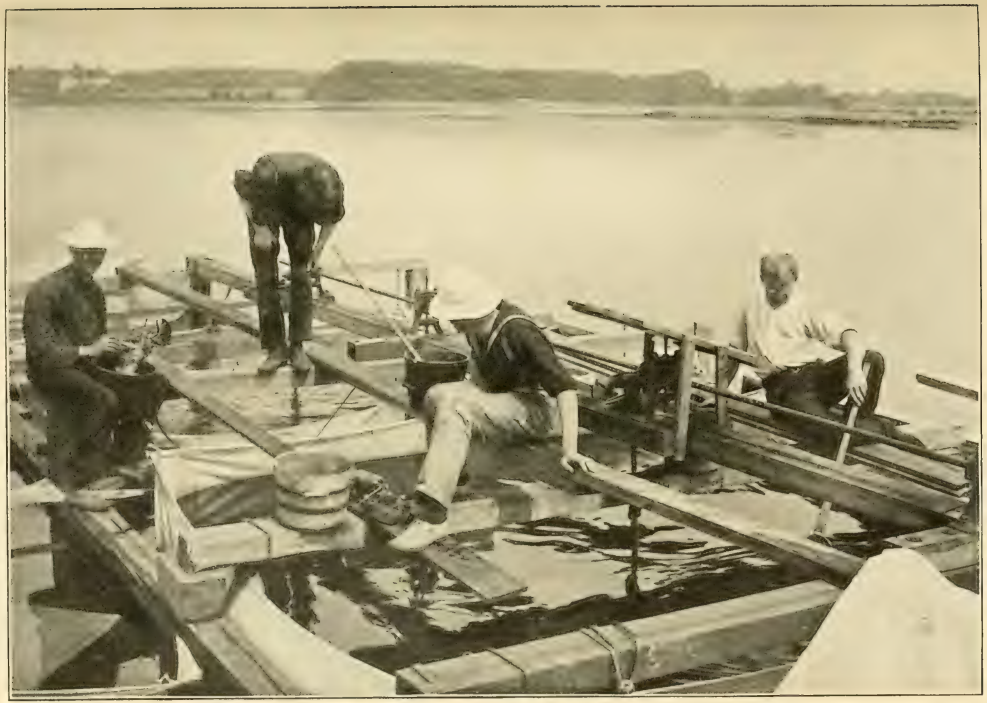


PLATE V.—Shows some of the assistants working on a bag. One may be observed counting out fourth stage lobsters, another scraping the eggs from a female lobster preparatory to putting them in the hatching bags.

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 meet 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 fray 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,

X, Fish produced, artificial nest.

O, Fish produced, natural nest.

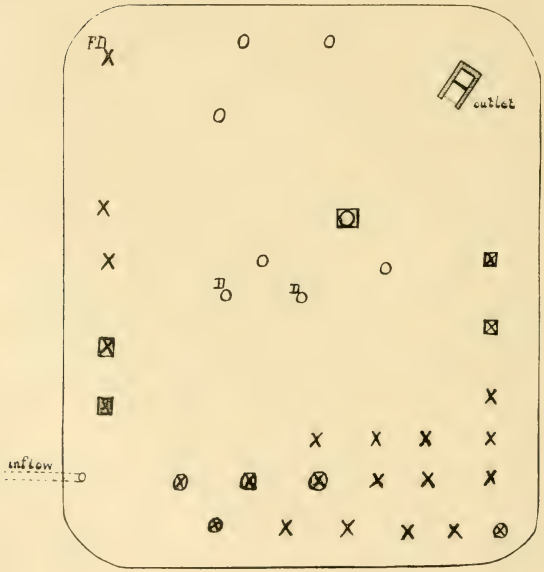
⊗, Artificial nest not used.

⊡, Natural nest cleaned but not used.

⊠, Eggs died, artificial nest.

DO, Eggs died, natural nest.

FD X Fish died, artificial nest.



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 N 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*, *Cerratophyllum*, 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. Potomogeton crispus.
5. Potomogeton 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 2½ 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 Potomogeton 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 enthusiatic 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 plants 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 watchd 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 vermillion 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 49½, 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 1½ 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 40½ 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 39½, 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 temperaure 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 Constantia 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 speciments 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 69 degrees and the period of complete incubation was in about twelve days.

Almost immediately on hatching the little creatures clung closely to the gelatenous 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 maloderous, 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 preditory 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 scarecrows.

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. Meeham 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, Barschall, *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 Waterest 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.*

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. Nicoly 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.*
Maccleay, William, *President of the Fisheries Commission of New South Wales, Sydney, N. S. W.*
Marston, R. B., Esq., *Editor of the Fishing Gazette, London, England.*
Olsen, O. T., *Grimsby, England.*
Sars, Prof. G. O., *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
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.

The thirty-fifth annual meeting of the American Fisheries Society will be held July 24, 25, 26. 1906, at Grand Rapids, Michigan, U. S. A.

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED SIX

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-fifth Annual Meeting

JULY 24, 25 AND 26, 1906,

At Grand Rapids, Michigan.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS,
1906.

Officers for 1906-1907.

President.....E. A. Birge, Madison, Wis.

Vice-President.....H. M. Smith, Washington, D. C.

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

Corresponding Secretary, Charles G. Atkins, East Orland, Me.

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

EXECUTIVE COMMITTEE.

John D. Whish, *Chairman*, Albany, N. Y.

E. Hart Geer, Hadlyme, Conn.

J. A. Henshall, Bozeman, Mont.

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
37. E. A. Birge.....1906-1907

CONTENTS.

PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, July 24, 1906.

Convention called to order at 12 m. by the President Mr. C. D. Joslyn, of Detroit, Michigan, at the Board of Trade Building, Grand Rapids, Michigan.

President: Gentlemen of the American Fisheries Society, I take pleasure in calling you to order for the thirty-fifth meeting of this society. This is not the time nor the occasion for a speech from your president. We have quite a large membership and quite a large number present in the city. The incoming trains are just about due now and will bring probably quite an addition to our numbers, but I have thought, in view of the fact that we have some guests present and we have the mayor of the city of Grand Rapids from whom we wish to hear, that I would call you to order at this time without waiting for the members who will be in here later.

Last year I think those of us who met with you at White Sulphur Springs told you that if you would come to Grand Rapids you would never be sorry, and I may say to you now that the city of Grand Rapids is one of the very best in the country. As the Hon. James G. Blaine once said, it is the largest city for its size that there is in the country. Its hospitality is unbounded, and as soon as the citizens of this city knew that we were to meet here they were only anxious to know what we wanted them to do, and they have showered honors and invitations upon us, some of which we will not be able to accept, and do business at the same time. They would entertain us during the three days that we were here, and not give us a chance to work at all if we would let them. We have with us here, as usual, our old and honored friend, our ex-president, Mr. Root. Long may he live and meet with us! We have probably the most con-

venient man in the country also with us, our treasurer, Mr. Willard, who pays the bills and debts of the society and trusts to us to reimburse him later on. (Great laughter and applause.) We also have with us as usual, our secretary, Mr. Peabody, who does all the work in preparing for these meetings and gets out the reports afterwards; then, of course, the president takes the credit for the entire job. (Applause.) I might go on and mention the familiar faces that we see here, but it is not necessary; it is good to see all these familiar faces again.

I now take pleasure, gentlemen, in introducing to you the mayor of Grand Rapids, Mr. Ellis, who will welcome you.

Mr. George E. Ellis of Grand Rapids: Mr. President and gentlemen, it is surely a great pleasure to say to you a few words just now, although at this particular hour I know that you do not expect very much. It is a good deal like a man who was invited to talk to a Sunday school class and he said: "Now, children what would you rather I would talk about." One of them said: "We would rather you would talk about a minute." (Laughter.) I guess that is about the way it is now, as it is so nearly your luncheon hour.

Your president is feeling especially good today. He was telling of a little incident that happened to him in Detroit the other day. He came down town and he told how well he felt. He said, "I feel better than I have for a long while, because my wife thinks I am such a good man. Why, this morning before I came down she told me that I was a model husband." So he told that to two or three people, and he was so pleased that he finally met his pastor and he told him about it. And he said, "Mr. Joslyn, before you tell that to many more people you better look in the dictionary and find out what 'model' means, and then you will learn just what kind of a husband you are." So he looked in the dictionary and found out that a 'model' was 'a small imitation of the real thing.' (Laughter.)

Now we are greatly pleased to see you here, and while you are in the city there will be no closed season, and you can go in any part that you want, and I will guarantee in this metropolitan city that, no matter what your desires and tastes are, you can gratify them, (laughter and applause) and if you do not find

it with ease, I see the four gentlemen here who represent the Grand Rapids committee and I will guarantee they can tell you very easily where it is, because they have been there themselves. (Laughter.) Mr. Adams, who was going to speak a few words to you, had a dream the other day, and he dreamt that he had got into heaven, strange as it may seem, and he told his wife how he had trod the streets of the New Jerusalem and what great sights he saw; and she said, "Fred, if you ever got into such a nice place as that, what made you get out?" "Why," he said, "the heat woke me up!" (Laughter.) Now, no matter how hot or cold it is, it is always good weather when good fellows are together, and if there are any people who are good fellows and enjoy associating together, it is the fishermen; you will make more lasting friendships when you are fishing or hunting than in any other line that I can recall, and in that it reminds me of a little saying on old friends which I will give you.

"Make new friends but keep the old,
For the new are silver but the old are gold.
New-made friends like new-made wine,
With age may mellow and refine.
Unlike old age with hair so gray,
True friendship never can decay.
So make new friends but keep the old,
For the new are silver but the old are gold." (Applause.)

President: Before we go to our lunch, gentlemen, I want to say to you that they have a real sportsman's association here in Grand Rapids, with all that that implies. That being so, I desire to call on the president of that association to say a few words of welcome to us. I should be very glad to have him come forward.

Mr. Otis A. Felger of Grand Rapids: The president is here under promise from me that under no circumstances would he be called upon, and he has engaged as his substitute, Mr. W. R. Shelby. He is not the president but a very active and honored member.

Mr. W. R. Shelby of Grand Rapids: Mr. President and Gentlemen of the American Fisheries Society: The gentleman introducing me to welcome you on behalf of the Consolidated

Sportsmen's Club of Grand Rapids says its President cannot make a speech, thus intimating that I can. I will say that while President Felger is too diffident to talk he is one of the finest shots in Michigan and takes pleasure in trying to teach me how to shoot, so that I am pleased to do some one thing better than he can. While not professing to be a public speaker I am inspired by the eloquence of your President and our Mayor, who preceded me, to say, that we are glad your Society has come to Grand Rapids to hold its annual meeting. I am connected with the Grand Rapids & Indiana Railway Company, which has always taken great interest and done much for the propagation of fish in Michigan and we welcome any effort to increase and maintain the finny tribe in our waters. The people of Grand Rapids and Michigan would be astonished and pleased to know the wealth the State gains by her fisheries; to know the number of people who come into the state only because it is a place to fish and because it has the "Fishing Line" to bring them. Tourists coming to Michigan to fish do not have to be told "when they go to a certain place that they should have gone over to the other place." They can catch fish anywhere in our rivers and lakes.

Our Mayor calls attention to "This being your noon hour" and I will not detain you longer because after becoming better acquainted with you, will be able to talk more interestingly to you, but on behalf of the Sportsmen's Club I welcome you to Grand Rapids and hope your visit will be pleasant and the object of your Society materially advanced by your presence and stay among us.

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

Alford, Jabe, *Madison, Wis.*
Atkins, Chas. G., *East Orland, Maine.*
Avery, Charles, *Hutchinson, Minn.*

Bartlett, S. P., *Quincy, Ill.*
Bassett, C. R., *Paw Paw, Mich.*
Bean, Tarleton H., *New York City.*
Birge, E. A., *Madison, Wis.*
Boardman, W. H., *Central Falls, R. I.*
Bower, Seymour, *Detroit, Mich.*

Bower, Ward T., *Northville, Mich.*
Brass, J. L., *Drayton Plains, Mich.*
Brewer, E. S., *Owosso, Mich.*
Brown, George M., *Detroit, Mich.*

Carter, George L., *Lincoln, Neb.*
Clark, Frank N., *Northville, Mich.*
Clark, Fred, *Mill Creek, Mich.*
Cutler, William, *Mill Creek, Mich.*

Dean, H. D., *Neosho, Mo.*
Dickinson, G. C., *Harrietta, Mich.*

Filkins, B. G., *Northville, Mich.*
Fullerton, Sam F., *St. Paul, Minn.*

Gunckel, John E., *Toledo, Ohio.*

Hankinson, T. L., *Charleston, Ill.*
Hogan, J. J., *La Crosse, Wis.*
Hughes, Wm. H., *St. Louis, Mo.*

Johnson, R. S., *Manchester, Iowa.*

Lydell, Dwight, *Mill Creek, Mich.*

Marks, J. P., *Paris, Mich.*
Meehan, W. E., *Harrisburg, Pa.*
Monroe, Otis, *Mill Creek, Mich.*
Monroe, Wm., *Mill Creek, Mich.*
Morcher, George, *London, Ohio.*
Morton, William P., *Providence, R. I.*

Nevin, James, *Madison, Wis.*

O'Brien, W. J., *South Bend, Nebraska.*

Peabody, George F., *Appleton, Wis.*
Porter, Richard, *Paris, Mo.*

Reighard, J. E., *Ann Arbor, Mich.*
Roberts, A. D., *Woonsocket, R. I.*
Root, Henry T., *Providence, R. I.*
Rosenbery, Albert, *Kalamazoo, Mich.*

Shortal, J. M., *906 Chestnut St., St. Louis, Mo.*

Thayer, W. W., *Detroit, Mich.*
Titcomb, Jno. W., *Washington, D. C.*

Whish, John D., *Albany, N. Y.*
Willard, C. W., *Westerly, R. I.*
Wires, S. P., *Duluth, Mich.*

Zalsman, Phil. G., *Paris, Mich.*

Registered attendance of Visitors:

Adams, Fred J., Editor, *Grand Rapids, Mich.*

Ellis, George E., Mayor, *Grand Rapids, Mich.*

Felger, Otis A., *Grand Rapids, Mich.*

Roth, Prof. Filibert, *Ann Arbor, Mich.*

Shelby, W. R., *Grand Rapids, Mich., Vice President Grand Rapids & Indiana Railway Co.*

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 25, 1905, to July 24, 1906:

RECEIPTS.

1905.		
Life membership fees	$ 60.00	
Yearly dues	647.10	
Sale of reports	25.30	
		$732.40

EXPENDITURES.

July 25—Balance due Treasurer	$111.87	
July 27—C. G. Atkins, printing	2.66	
Aug. 29—Stamped envelopes	10.70	
Sept. 18—Murray Lyceum Bureau, stereopticon	4.25	
Oct. 7—A. H. Dinsmore, stereopticon	5.00	
Oct. 10—One letter file	.35	
Nov. 6—Stamped envelopes	10.70	
Dec. 22—Telegram to Geo. F. Peabody, Secretary	.70	
Dec. 23—Typewriting	1.25	
Dec. 23—H. D. Goodwin, stenographer	202.00	
1906.		
Mar. 15—Post Publishing Co., reports	289.15	
Mar. 15—G. F. Peabody, Sec'y, mailing reports, etc	74.85	
Apr. 14—Gibson Bros., circulars	3.15	
July 11—Stamped envelopes	10.70	
July 17—Post Publishing Co., circulars, etc	15.50	
July 17—Geo. F. Peabody, Sec'y, stamps, etc	16.35	
	$759.18	
July 24—Balance due Treasurer		$ 26.78
		$759.18

Respectfully submitted,
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. Geo. M. Brown, Mr. R. S. Johnson, and Mr. A. D. Roberts.

The following is a list of applicants for membership in the association, made since the last meeting:

Alford, Jabe, *Fish Commissioner, Wis., Madison, Wis.* (Proposed by E. A. Birge.)

Avery, Charles, *Minnesota Fish and Game Commission, Hutchinson, Minn.* (Proposed by Samuel F. Fullerton.)

Bassett, C. R., *Glen Springs Trout Co., Paw Paw, Mich.*

Bassett, F. R., *Glen Springs Trout Co., Paw Paw, Mich.*

Bigelow, Hayes, *Brattleboro, Vt.* (By H. M. Smith.)

Brown, Thomas W., *Minnesota Fish and Game Association, Glenwood, Minn.* (By S. F. Fullerton.)

Burkhaus, Jerry H., *Torresdale Hatchery, Holmesburg, Philadelphia, Pa.* (By W. E. Meehan.)

Canfield, H. L., *Bureau of Fisheries, Washington, D. C.* (By Frank N. Clark.)

Carter, George L., *Lincoln, Neb.* (By W. J. O'Brien.)

Conway, R. J., *Director Aquarium, Belle Isle, Detroit, Mich.* (By Frank N. Clark.)

Cutter, William, *Mill Creek, Mich.* (By Dwight Lydell.)

Cheyney, John K., *Tarpon Springs, Florida.* (By H. M. Smith.)

Davies, David, *Bureau of Fisheries, Northville, Mich.* (By Frank N. Clark.)

Delaney, O. J., *129 Front St., New York.* (By H. M. Smith.)

Dickinson, G. C., *Fish Culturist, Harrietta, Mich.* (By Seymour Bower.)

Evans, A. Kelly, *Secretary Ontario Fish and Game Protective Association, 25 Front St., East Toronto, Ontario.* (By T. S. Palmer.)

Grill, John H., *Vice President, Minnesota Fish and Game Commission, Sherburne, Minn.* (By Samuel F. Fullerton.)

Hankinson, T. L., *Charleston, Ill.* (By Prof. J. E. Reighard.)

Hartman, Philip, *Erie Hatchery, Erie, Pa.* (By W. W. Meehan.)

Hughes, William H., *Vice President Missouri Fish Commission. 221 Wainwright Bldg., St. Louis, Mo.* (By C. W. Willard.)

Johnson, O. J., *President Minnesota Game and Fish Association; Glenwood, Minn.* (By Samuel F. Fullerton.)

Leisenring, W. A., *Mauch Chunk, Pa.* (By W. E. Meehan.)

Locher, William, *Kalamazoo, Mich.* (By Frank Lydell.)

Marty, John M., *Fish Culturist, Minnesota Fish and Game Commission, St. Paul, Minn.* (By Samuel F. Fullerton.)

Pennington, Robert, *Wilmington, Delaware.* (By H. M. Smith.)

Porter, Richard, *President Missouri Fish Commission, Paris, Mo.* (By C. W. Willard.)

Shortal, J. M., *Secretary Missouri Fish Commission, 906 Chestnut St., St. Louis, Mo.* (By C. W. Willard.)

Thomas, H. G., *Bureau of Fisheries Station, Put-in-Bay, Ohio.* (By J. W. Titcomb.)

Tinker, Eugene, *Corry Hatchery, Corry, Pa.* (By W. E. Meehan.)

Waddell, John, *Grand Rapids.* (By Frank Lydell.)

Whipple, James S., *Forest, Fish and Game Commission, Capitol, Albany.* (By John D. Whish.)

Wolters, Charles A., *Prospect Brewery, 12th and Mervine Sts., Philadelphia, Pa.* (By W. E. Meehan.)

Motion made and seconded that the rules of the society be suspended and that the secretary be authorized to cast the unanimous ballot of the meeting electing the foregoing applicants to membership in the society.

Motion unanimously carried.

The secretary cast the ballot pursuant to the motion.

President: The applicants are unanimously elected to membership in this society.

The following gentlemen were unanimously elected honorary members of the society:

Prof. Dr. Franz Steindachner, *Royal Natural History Museum, Vienna, Austria.*

Prof. Edmond Perrier, *Director National Museum of Natural History, Paris, France.*

*Prof. P. P. C. Hoek, *Scientific Fishery Adviser of the Dutch Government, The Hague, Holland.*

Dr. Oscar von Grimm, *Inspector-General of Fisheries, St. Petersburg, Russia.*

Mr. Franz von Pirko, *President Austrian Fishery Society, Vienna, Austria.*

Mr. Guiseppe Besana, *President Lombardy Fishery Society, Via Torino 51, Milan, Italy.*

Dr. Decio Vinciguerra, *Director Royal Fish Cultural Station and Aquarium, Rome, Italy.*

Mr. Fred J. Adams, *Grand Rapids, Mich.*

President: Before we take a recess for our luncheon I will inquire if there is any specific matter that ought to be brought up at this time. If there is we can consider it.

It devolves upon the presiding officer to appoint standing committees. I have busied myself as well as I could during the morning hour, and in view of the fact that there is always more or less of a contest on two important matters, I have deemed it wise to name two of the committees now and reserve the privilege, if I may, of naming the other committees some time during the afternoon session.

The first committee that the presiding officer is called upon to name is that on nominations. The other is the committee on location. Of course, in regard to the first, I know myself that it is a high honor and that there will be various applicants and I thought, if that committee was named now so that those who have claims to present would have the time to do it, it might be perhaps more convenient. As to the location, we all know that there are a great many places that seek to have us hold our meeting there, and likewise there would probably be some contest,

*On furlough until autumn 1907, as General Secretary to the International Council for the Study of the Sea, Copenhagen, Denmark.

and I have, therefore, thought it wise to name that committee as well.

For the committee on nominations I have thought the society could do no better than to have me name Mr. Henry T. Root as the chairman. The other members of that committee are Mr. Frank N. Clark of Northville; our old friend who is somewhat ill but has been a long while with the society and a valued member of it, whom you all know, Mr. J. J. Hogan of La Crosse, Wis.; Dr. T. H. Bean, whom you all know, who has been with us a long time, and Mr. S. P. Wires.

As committee on location I will name the following gentlemen: Samuel F. Fullerton, Mr. W. E. Meehan, Mr. C. W. Willard, Mr. Herbert D. Dean, and Dr. E. A. Birge.

Mr. Clark: There is one important committee I think necessary at this time which is a programme committee for the present meeting. We have always had one appointed.

President: I think this suggestion is wise and with the permission of the society I will name our worthy secretary, Mr. Peabody, as chairman, Mr. John W. Titcomb and Mr. Dwight Lydell.

I desire to suggest at this time that the Grand Rapids committee on arrangements, as some of you and perhaps all of you know, have arranged for a banquet some time tomorrow evening. It has been suggested to me that seven o'clock would be a convenient hour. One of the reasons why that hour has been suggested is this: they have most graciously put at the disposal of this society an electric car or sufficient electric cars to transport the entire society to the Lakeside Club, where the banquet is to be held, and it was suggested in the same connection that a visit to the state hatchery at Mill Creek be taken also in the afternoon, so that we could take the car about four or five o'clock, or whatever time is agreed upon, and go down to the hatchery, look that over, and then the same car would transport us to the Lakeside Club where we have our banquet.

It will be remembered by those who attended the meeting last year that a resolution was adopted, which, of course, would not be binding upon this meeting but was a suggestion, that the forenoon of the second day of the meeting should be given up entire-

ly to committee meetings and be an open date, so far as the society was concerned; but if you should determine to take the afternoon to go over to the hatchery, perhaps the suggestion that we meet in the morning to transact some business and have some papers read would not be out of the way, and if that meets with your views we will do so.

Mr. Root: I move that when we meet we meet here tomorrow morning at 9:30 o'clock for the transaction of any business that may come before us.

Mr. Titcomb: Was not this committee on programme appointed for the purpose of laying out the whole of this business from now until we get through?

President: Yes. I suppose we had better refer the whole matter to the committee on programme.

Mr. Clark: I move that this matter be referred to the committee on programme.

Motion seconded and unanimously carried.

President: I take the liberty in behalf of the society to thank our friend, the mayor, and Mr. Felger as representing the Sportsmen's Association, for their kind words and for their invitation, and while I shall not avail myself of the suggestion to visit the places suggested by the mayor, undoubtedly a great many members of the society will. (Laughter.)

A recess was here taken until 2:30 p. m., same day and place.

AFTERNOON SESSION.

Same day, Tuesday, July 24, 1906, 2:30 p. m., same place. Meeting called to order by the president.

President: I understand that the programme committee is ready to report, and as we are without any real order of business until we get that report, I will call for the reading of it now.

Mr. George F. Peabody of Appleton: The committee recommends the adoption of the following programme:

Tuesday, July 24, 1906, 2:30 p. m.

Reports of committees and unfinished business.

Election of members always in order.

Reading and discussion of papers in the order suggested by committee on programme.

Adjourn 5:30 p. m.

Evening session at 8 p. m. sharp at Ryerson library.

Illustrated lecture by Professor J. E. Reighard.

The subject of that lecture is Nest Building Fishes of Michigan.

Wednesday, July 25. Meet at 9 a. m.

Reading and discussion of papers.

Adjourn at 1 p. m. until 3 p. m.

At 3 p. m. take special car or cars in front of Hotel Pantlind for Mill Creek Hatchery.

Paper by Dwight Lydell, also by Professor Reighard.

Return from Mill Creek to Lakeside Club without stop.

Guests of the club for the evening.

Thursday, July 26.

Leave Union Depot at 7:30 a. m. for Paris.

Hold a meeting there after examining the station.

Have dinner as guests of Michigan Fish Commission.

Leave Mill Creek at 2:20 p. m. for Grand Rapids.

Meeting will then adjourn.

President: In regard to the trip to the Paris Hatchery I would state that, of course, we would expect all the members and guests of the society to go, and we certainly hope and expect that our friends will come along with us so that we may enjoy the trip and the inspection of the hatchery, and probably get in somewhere during the time a business meeting as well.

We will now receive the report of the secretary.

Secretary: Mr. President, the secretary's report is embodied in the published proceedings for last year, which covers the entire report. These proceedings are in the hands of every member of the society.

President: It seems to me that it is a most complete report in every detail.

Mr. Root: I move that the report be received and adopted. Motion seconded and unanimously carried.

President: We will now receive the reports of standing committees, and first the executive committee.

Mr. Meehan: I shall have to hand in the report in writing a little later to the committee, but I can give it to you verbally. I could not give it in writing before because some of the data had not been handed to me until this morning. I have to report that during the year there were seven deaths in the membership reported to either the treasurer or myself.

W. Osborne of Duluth, Minnesota, who died April 1. 1905.

W. E. Robinson of Mackinaw City, Michigan, who died in 1905.

E. St. George Tucker, who died in Halifax in 1904.

J. C. Willetts, New York City, who died August 31, 1905.

Judge Uri Lamprey, St. Paul, Minnesota, May, 1906.

Robert B. Roosevelt, New York, June, 1906.

Charles L. Miller, Altoona, Pa., Oct. 21, 1905.

Charles Walters, Jr., Philadelphia, Oct. 13, 1905.

Henry C. Demuth, Lancaster, Pa., May 30, 1906.

Mr. Demuth was for many years connected with the fishery interests of Pennsylvania, having been the treasurer of the old fish commission for seven years, and was a co-laborer on the board with the late Henry C. Ford whom we all knew as prominent in the fish cultural work of Pennsylvania between 1880 and 1895.

I also have to report that another and great step has been taken toward securing practically uniform laws for the protection of fish in Lake Erie, Ohio, having passed last winter laws practically the same as Pennsylvania did the year before. A bill was introduced into the New York legislature—I heard informally that it has passed—but apparently it has not, at least Mr. Whish informs me that he does not know positively that it has been passed. Canada, of course, does not need to enact special legislation but will adopt similar regulations as soon as all the states bordering on Lake Erie adopt practically uniform laws.

We have also had some correspondence in connection with the International Fisheries Society, but that matter is largely in the hands of Dr. Smith.

Mr. Titcomb: I move that the report be accepted and adopted; that the list of names of the deceased members be referred to the committee on resolutions for proper action in this connection.

Motion seconded and unanimously carried.

Mr. Titcomb: As a member of the committee on foreign relations I wish to present a matter at this time, because it must be attended to now if at all. You will probably remember Mr. De Puy, a comparatively new member from New York, who attended the last meeting of the society. He is going on a two years' trip, and he will visit many countries—in fact nearly all the countries in the world—before he returns. He is an enthusiastic angler and very much interested in the society. I offer a resolution this afternoon in order that it may reach him when he takes his boat. If it is mailed tomorrow morning by the secretary it will do so.

The resolution is as follows:

Resolved by the American Fisheries Society, here assembled in annual meeting, that Mr. Henry F. De Puy be added to the committee on foreign relations and made a delegate of this society to all foreign countries which he may visit during his contemplated sojourn abroad.

It is further resolved that the secretary be instructed to send a copy of these resolutions to Mr. De Puy with the best wishes of the society for a pleasant trip; and a formal certificate addressed "To whom it may concern," stating that Mr. De Puy is a delegate authorized to confer with fish culturists and to represent this society at any meetings or conferences he may find it convenient to attend during his absence in foreign countries; said certificate to be signed by the president and the secretary of the society.

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

Mr. John E. Gunckel of Toledo, O.: Within the past twenty-five years I have been recording secretary several times, and when I was recording secretary you always asked for my report. You still have a recording secretary and I would like to hear his report so as to learn what improvements have been made since the

time when I held office. You know, of course, I live in Toledo and have the reputation of being the biggest fish liar in the United States; but I continually receive letters of inquiry from foreign countries, and some very curious scientific questions are being asked me. The angling part of it I take a great deal of pleasure in answering, but you would be surprised to see the correspondence I have from foreign countries about the American Fisheries Society, although I have not been recording secretary for many years.

Mr. Peabody: As recording secretary I would like to ask why the gentleman does not refer this correspondence to the present recording secretary?

Mr. Gunckel: I generally refer everything of a scientific nature to you, but as to the other matters I perform my duties under my salary and answer the communications myself.

Mr. Peabody: I have a communication from Dr. Smith that perhaps would come under the head of unfinished business. It is as follows:

You will recall that I corresponded with the officers and the executive committee relative to an award to be offered by the Society at the next International Fishery Congress. All responded favorably, and the majority of those who suggested any subject for the award mentioned fish diseases. Accordingly, I made the following announcement in the circular which has been sent to the members:

"By the American Fisheries Society: For a paper embodying the most important original observations and investigations regarding the cause, treatment and prevention of a disease affecting a species of fish under cultivation, $100 in gold."

Will you please bring this matter to the notice of the Society, and have the foregoing action ratified?

Dr. Birge: I move that the action of Dr. Smith be ratified and accepted as the action of the society.

Motion seconded and unanimously carried.

Prof. Jacob Reighard then presented a paper on "The Identification for Legal Purposes of Mutilated or Dressed Specimens of Whitefish and Herring from the Great Lakes."

Prof. Reighard: This paper and the one that follows on the programme are announced as illustrated by lantern slides. When the local committee made its arrangements, they thought, from the fact that lantern slides were mentioned in the programme that this paper might be suitable for the general public and therefore placed it in the evening. On learning of this action I undertook to give an evening lecture that would possibly interest the general public more than this paper, and I have therefore cut out the lantern slides from this paper, but I have here three or four photographs which will serve to illustrate it.

Mr. Samuel F. Fullerton of St. Paul, Minnesota, read a paper on "Protection as an Aid to Propagation."

Mr. George F. Peabody then read a paper by Mr. Albert Rosenberg of Kalamazoo, Michigan: "Some Experiments in the Propagation of Rainbow Trout."

Mr. Titcomb then read a paper by Dr. Hugh M. Smith, on "Fishery Legislation before the Fifty-ninth Congress," (first session).

Mr. Titcomb: I think it would be a good idea if the society could have at each meeting the bound volumes of the proceedings of the society for all the years. My suggestion is that the secretary be authorized to have a set of the transactions of the society bound and put in a proper box which can be taken from one meeting to another, and during the sessions be accessible to all the members, and I make a motion to that effect.

Motion seconded and unanimously carried.

Mr. Titcomb: I move that the auditing committee be also made a committee to co-operate with the secretary and treasurer, in order to weed out delinquent and deceased members from the present list and revise the list for the next publication. Some of the addresses now given are wrong. Some have passed away, and Mr. Willard can undoubtedly report on some who have not paid for years. Is not that so?

Mr. Willard: I can.

Motion seconded and unanimously carried.

President: I will appoint as the auditing committee:

Mr. George M. Brown, of Michigan; Mr. A. D. Roberts, of Rhode Island; Mr. R. S. Johnson, of Iowa.

As members of the committee on resolutions I will appoint: Mr. John D. Whish, of New York; Mr. W. E. Meehan, of Pennsylvania; Mr. John W. Titcomb, of Washington, D. C.

Mr. Meehan read a statement of the fish distributed by Pennsylvania from January 1, 1906 to July 1, 1906.

Adjourned to 8 o'clock p. m., same day, at the Ryerson Public Library.

EVENING SESSION.

Public Library, same day, 8 p. m. Prof. Jacob Reighard delivered a lecture on the subject of the Domestic Life of Fishes that Build Nests and Take Care of Their Eggs.

Adjourned to next day, Wednesday, July 25, 1906.

Wednesday, July 25, 1906.

Board of Trade Building, Grand Rapids, Michigan, July 25, 1906, 10 a. m. Meeting called to order by the President.

Mr. Titcomb: There is an organization in this country called the American Breeders' Association, formed two years ago by the Assistant Secretary of Agriculture. This association has taken up the work of improving breeds of animals and plants. You have undoubtedly all read about Burbank's work out in California, the wonderful things he has accomplished in plant life of all kinds.

Now the American Breeders' Association has the work divided up by committees, each committee having a special line. I was made chairman of the committee on fish breeding and was requested to ask the co-operation of all members of this society in certain lines. For instance, we would like to know from every one who has done any work on hybridization of fishes, details as to what they have done, and how far the work has been carried. We would like to have every one who has done any fish cultural work, or who has had any opportunity to do fish cultural work, continue still farther these attempts to cross different species.

Now it is very surprising to think that you can take the eggs of a 50-pound rock bass and fertilize them with the milt of the herring, or the opposite, though, of course, with that class of fish it is almost impossible to carry your experiments to a conclusion, because the fish are liberated as fry and go to the ocean. But we want to take up this subject of hybridization on a larger scale, cross the inferior species perhaps with some finer ones, and rear the fish to see if we can get any results by continual attempts at crossing.

Then this committee wants to take up some other subjects. This will apply more to the commercial hatcheries such as improvement by selection. We would like reports on what has been done by commercial breeders, breeding for increase on egg production, breeding for resistance or immunity to disease. There is a large field in those directions, and the data on what has been done in the past are very limited.

The committee appointed by this association consists, besides the chairman, of Mr. Seymour Bower, of Detroit; Mr. C. A. Vogelsang, of San Francisco; Mr. Charles G. Atkins, of East Orland, Me.; Mr. C. C. Wood, of Plymouth, Mass.; Mr. H. M. Smith, of Washington, D. C.; Mr. W. J. Moenkhaus, of Bloomington, Ind.; Mr. A. D. Mead, of Providence, Rhode Island; Mr. H. J. Wolf, of Philadelphia, Pennsylvania; and Dr. George W. Field, of Boston, Massachusetts.

Mr. Meehan: Do I understand you to say that there was successful fertilization between the rock-fish or striped bass and the herring?

Mr. Titcomb: Yes sir.

Mr. Clark: By what association was this committee appointed?

Mr. Titcomb: Appointed by the American Breeders' Association which really originated in the Department of Agriculture. The association advised this committee, and I think this society ought to co-operate with it in every way they can.

Prof. Reighard: That is a committee of the Breeders' Association and not of this society.

Mr. Titcomb: That is true.

Mr. President: Any suggestion or resolution in connection with this?

Mr. Titcomb: No. I thought it would get on the record in the report in this way, so that the members would contribute when anything occurs to them.

President: It occurs to the president that this is a very wide subject. The representatives from the different states who are in charge of fish culture in those states, would do well to take heed to these suggestions by Mr. Titcomb, with a view to ascertaining what results can be produced. In a year or two we will be getting reports I believe that will be of value to all the states.

We will now listen to the report of the committee on nominations.

Mr. Root: When you appointed me on this committee you gave me what you believed to be a pretty difficult task. You were never more mistaken in your life. I never sat on a committee where there was more unanimity. There was not a suggestion contrary to what I shall report. Of course in a society of this size there are a great many men who are worthy of being president and capable of it and whom we would like to see in that office but we cannot all get there the same year.

The first nomination made was of a gentleman for president who not only has an international reputation—and these are international days, you know—we have to have a little "international" in everything—but he also has a great local reputation as a scientist and practical fish culturist; and I am glad to say that he is one of your western men. Without further remarks I will put in nomination the list decided on in a very few minutes with perfect unanimity.

For President, Dr. E. A. Birge, of Madison, Wis.

For Vice President, Dr. H. M. Smith, of Washington, D. C.

And let me say right here that Dr. Smith would naturally have been nominated for president this year, but we all know of the great international congress that is coming, and it was the feeling of the committee that he should be nominated for

our president next year. Of course that will be for the next year's meeting of the society to say.

For Recording Secretary, George F. Peabody, of Appleton, Wisconsin.

For Corresponding Secretary, Charles G. Atkins, of East Orland, Me.

We had a good deal more discussion about the treasurer than anything else. (Laughter.)

C. W. Willard, of Westerly, Rhode Island.

Executive Committee:

John D. Whish, Chairman, Albany, New York.

Mr. E. Hart Geer, Hadlyme, Conn.

J. S. Henshall, Bozeman, Mont.

S. F. Fullerton, St. Paul, Minn.

Prof. Reighard: I move that the rules be suspended and that the secretary be instructed to cast the unanimous ballot of the society for the entire list of nominees as read by the chairman.

Seconded, unanimously carried and so done.

Dr. Birge was called for. (Great applause.)

Dr. Birge: I feel it is a great honor to be elected president of this society. I shall endeavor to perform the duties of the office to the best of my ability, and I trust the meeting over which I hope to preside a year from now will be a successful one.

(Mr. Titcomb called for.)

Mr. Titcomb: I am sure if I say anything for Dr. Smith I shall be talking for a man that won't blow for himself; he is one of the most modest men I ever knew, a thorough gentleman, who is well posted on the work of the Bureau of Fisheries, the results of many years' experience. His heart is in this work and in the later years I have been pleased to see him take such an active interest in this society. I think he has secured more members in the last two years than any other member here. I am sure we have not made a mistake in honoring him with the position of vice president and I hope on the occasion of the International Fisheries Congress that he will be the president of this society.

President: I know you will all be glad to hear from the newly elected chairman of the executive committee.

Mr. Whish: Mr. President and gentlemen, after reading our constitution carefully and consulting with the members of the committee, I will know more about what this committee is expected to do than at the present time. Of course our progress will be largely guided by the very efficient executive committee preceding this committee. A considerable experience in organized bodies has led me to believe that the executive committee is not a place for play. It ought to be a place for work, and in a body like this, for a lot of good work. The able men with whom I shall be associated will undoubtedly make up for deficiencies on my part; and I sincerely hope the work this new committee does will be as satisfactory to the society as has been the work of similar committees in the past. Any suggestions which any member may have in mind will be gladly received by this committee, I know. I shall be glad at any time to hear any suggestions from any member of the society, and inasmuch as my name is easily written and my address is readily remembered, there will be no difficulty in reaching me, there being fortunately only one family of my name in the United States that I know, and certainly only one man of that name located in the capitol at Albany.

Thank you for the very high honor I have received. (Great applause.)

(Secretary Peabody was called for.)

Mr. Peabody: Gentlemen, I feel very grateful for the honor of being continued as secretary, but my gratitude is somewhat tempered by the knowledge that the only reason I am made secretary is because nobody else will take the office, (great laughter) and I must admit that there are some defects perhaps in my administration. It is very difficult to keep a correct record of the addresses. There is a very large number of men belonging to the society whose dwelling place changes, and I would ask every one to be particular and send me any change of address, that it may be properly recorded, so that all the members may get the documents, pamphlets and whatever is sent out by the society.

President: The general promoter of the financial welfare of the society is called for—Mr. Willard.

Mr. Willard: I did not hear any one call for me.

President: I can speak louder. (Laughter.)

Mr. Willard: I deem it an honor to serve this society in any capacity and I thank you very much for this further evidence of your confidence and esteem, and I will try to serve you as faithfully in the future as I have in the past. If there is a shortage I will make it up. (Great applause.) If there is a superabundance of funds I will divide with you. (Laughter.)

President: That is very fair indeed.

I am glad to see the society return to a course which I believe is the wisest it can pursue, in selecting for its president such a man as Dr. Birge. I have honestly felt that while I am identified somewhat with the fish cultural work of Michigan, I am not a well-known scientist, and indeed not a scientist at all, and it has seemed to me during the entire time that I have held this office that the interests of the society would have been much better promoted had it then selected some well known scientist of international reputation as its president; and it is well for the society to return to the policy of selecting such men as Dr. Birge, and other men whom I hope in the future will follow, as chief executive officers of this society. I am glad to say to Dr. Birge that the society in honoring him, in my opinion, has still more honored itself. As my predecessor said to me, I am obliged to say to you, that I cannot at this moment yield up the gavel to you, but at the close of the meeting here I shall turn it over to you with the utmost pleasure.

(Great applause.)

Dr. Birge: May I say just a word in reply to your kind words? I feel deeply the honor to science as well as the personal honor involved in my election as president. Yet I should feel it a very great misfortune to this society if that policy which you indicate should be adopted and pursued regularly. The great charm of this society, to all of us who are members, lies in the fact that it brings together not merely the scientists but all

those who are interested in fish culture, from every point of view. The standing of the society in the United States depends on the strong union of all interests for fish culture, and on having all of those interests represented in the society and in its officers. I am very glad, Mr. President, that you were elected President last year. It would be a misfortune if men who are interested in the practical culture of fish as you are, should feel themselves in any way barred from the control of the affairs of the society. Such a misfortune is impossible since a most important part of the control of the affairs of such a society as this comes from men who are interested from the point of view which you and your fellows in the society hold.

I need not say that the remarks of the President in regard to his own administration were altogether too modest because we all of us appreciate the success which the society has had during the past year and to which he has contributed so much.

Mr. Clark: If I am not trespassing upon the time of this society I would like to say, as a member of long standing in the organization, also as a practical fish culturist and not a scientist, I would like to say to Dr. Birge and the members, that the practical side of fish culture from now on must have more of the help of the scientist. In other words the successful practical fish culturist of today has to be a scientist so far as possible. We have come to that day and age when our farming, breeding and nearly all other pursuits are followed on well based scientific principles, and we must have more of the help of the scientist in fish cultural work. Therefore, I say, let the scientist element have better recognization than has been shown in the past.

President: I am compelled to tell a short story in regard to the outcome of this election. Away back in the 80's the State of Michigan had a very furious canvass on for the nomination for the position of governor, in the republican party. I think there were six candidates and all had about the same number of followers in the convention. The late Roswell G. Horr presided at that convention, and what he said to that convention before it opened its labors I would like to have regarded as said to this society with regard to the outcome here. He said, "Gentlemen, you are all here, each one earnestly active in support of his own

candidate, and thinking that the world swings around and will be governed by the success of his own candidate; but when it is all over and the final ballot is cast, every one of you will see then that the hand of Providence was in it from the start." (Laughter and applause.)

Is there any miscellaneous business to be taken up at this time?

Secretary: I should like to read the following communication:

Silver Lake, Mass., July 18th, 1906.

Mr. Geo. F. Peabody, Secretary, Grand Rapids, Mich.

Dear Sir: It is with sorrow that I write you that my father, Mr. George F. Lane, passed away yesterday.

He has been failing the last two years and died of a weakened heart.

He was taken away when the prospects of the trout business seemed the best, as he had more stock on hand at the time of his death than ever before. Yours truly,

HARRY L. LANE.

(This communication was referred to the committee on resolutions.)

Mr. Titcomb then read a paper on Progress and Experiments in Fish Culture in the Bureau of Fisheries During the Fiscal Year 1906.

Mr. Seymour Bower: I would like to have the chair take a rising vote as to the number of members who will go to Paris tomorrow.

President: It is rather necessary in order to make arrangements with the railroads that we know exactly who will go to Paris tomorrow, and in order to ascertain that, before Mr. Atkins starts with his paper, I will ask you to rise, stand and be counted.

Mr. Dean: There are some strangers here and we would like to know about the fare, etc.

Mr. Bower: If fifty go the fare will be $1.85 for the round

trip. If we cannot get fifty they will probably make a little higher rate, but will give special rates. If there are any strangers here who have not been to Paris, they will miss the opportunity of their lives if they do not go. The wild trout for a good dinner are all caught and ready to be dressed.

President: As I understand, everything has been caught but the men.

Mr. Dean: What time can we return to Grand Rapids?

Mr. Bower: We leave Grand Rapids at 7:30 in the morning and return here at 4:45 p. m.

A vote was taken and thirty-three said they would go.

Mr. Charles G. Atkins of East Orland, Me., read a paper on the subject of Experiments in the Fasting of Fry.

Dr. E. A. Birge then read a paper on the subject of Gases Dissolved in the Waters of Wisconsin Lakes.

Mr. Brown: In the absence of the President a couple of weeks ago, and in the line of our interests in beautifying our grounds as an object lesson at one place, and at another to beautify them and to protect the springs and streams that furnish the water of our hatcheries, I wrote to Prof. Filibert Roth of the Michigan University, asking him if he would make a few remarks on the line of forestry, which I thought would be easily adapted to our and many United States Stations very much to their advantage. He is present with us and we would like to have him give us the benefit of his experience.

Prof. Roth then addressed the society on the subject of The Fisherman and Reforestation.

Mr. Meehan then explained a new type of jars for hatching, designed by himself.

President: There are on the table here some circulars with reference to the International Fisheries Congress to be held in 1908 at Washington, showing the awards of premiums offered for different papers. They lie on the table and we will be glad to have the members take them as they pass out.

An adjournment was then taken to 3 o'clock p. m., same day, at Mill Creek.

AFTERNOON SESSION.

Mill Creek Hatchery, 4:30 p. m., same day. Convention called to order by the president.

Mr. Seymour Bower read a paper by Mr. Dwight Lydell of Mill Creek, on the subject of The Bass at Mill Creek Station.

Secretary Peabody: I have received a letter from Mr. Henry W. Beeman, of New Preston, Connecticut, who has been raising small-mouth black bass for about four years and has had remarkable success in their propagation. I requested a paper from him on the subject, but he has been too busy to prepare one, and he simply wrote a letter that has a few points in it that might be noteworthy to those interested in black bass.

The secretary then read the letter referred to.

Mr. Clark then read a paper by Mr. J. J. Stranahan of Cold Springs Station, Bureau of Fisheries, on Assorting Brood Black Bass to Prevent Cannibalism.

Mr. Lydell explained the advantages of Sherwin & Williams Pure Atchison Graphite Paint, for painting screens.

Mr. John L. Price, of Drayton Plains, Michigan, explained the advantages of a device invented by him, consisting of a tube for aerating water.

Meeting adjourned to convene at Lakeside Club, Grand Rapids, Michigan, at 8 p. m., same day.

EVENING SESSION.

At 8 p. m. a banquet under the auspices of the Consolidated Sportsman's Club was given at the Lakeside Club, Reed's Lake. Mr. Fred J. Adams acted as toastmaster. He said that he thought Michigan had one of the best fish commissions in the country, and that it was entirely out of politics; that the appropriation of the commission was small, but that they made every dollar count.

"Our lakes and streams are in excellent condition and they

would be in still better condition if they were properly protected, and the method of protection is a problem that still confronts us."

President Joslyn: I am very glad to hear these remarks of Mr. Adams commendatory on the work of the fish commission. I am proud to say that we really never have had any politics in the commission.

We have believed that the work in which the commission is engaged is a serious one; we have believed furthermore that it was a work which would interest the people of the state. We are engaged in the same work that you gentlemen of the society are engaged in—work not for ourselves, not for our immediate friends or relatives, but almost exclusively a work for those who are to come after us. Because of the character of our work we believe we can see what the future is to bring forth in regard to the food fishes of this country, unless some work like that in which we are engaged is done; and so I take pleasure in saying that, so far as the Michigan Fish Commission is concerned, and I know that so far as our society is concerned, we have let politics severely alone and given our whole time and attention to the work which we had in hand, and that is the reason, Mr. Toastmaster, why we could give so little time to the generous propostions for entertainment which you made when you found out that we were coming to Grand Rapids. But I will say to you, and I believe the members of this society will agree with me, that the papers which have been read at the meetings thus far held in Grand Rapids, and the discussions which followed the reading of those papers, have been of the very best, and will, beyond all question, be productive of good results, not only of advantage to us in Michigan, but to every fish and game commission throughout the United States which has had representatives here to hear and take part in these discussions.

I take occasion here now, because it probably will not again be afforded me, as our time will be fully taken up with other matters tomorrow, to say to you one and all that I most thoroughly and gratefully appreciate the honor which you gave to me a year ago, of presiding over your deliberations. It is an honor which I shall always remember and I realize that even if our

constitution did not prohibit, the years which have rolled over my head are so many that in the ordinary course of a lifetime, it is an honor which can never come to me again, and I want to return my thanks to this society for the courteous manner with which they have carried on their deliberations, and the respect they have paid each other and the dignity of the society, and I thank you gentlemen, one and all. (Great applause.)

The toastmaster then called upon the president-elect, Dr. E. A. Birge. (Great applause.)

Dr. Birge: There is only one thing I want to say and that perhaps I may say as coming from the next door neighbor of the state of Michigan. The state of Wisconsin has looked to Michigan for many good things. I know that perhaps better than any of you here, because we who have belonged to state universities anywhere in the country, look toward the University of Michigan as the mother of the state universities of the country. We have looked to Michigan for a great many years for help in state university affairs and have never failed to find it, we have looked to the University of Michigan as representing in a very high sense the State of Michigan, and we have been proud to recognize the state and the university together. As a member of the Fish Commission of a sister state, I may say that there too we have had great assistance from Michigan in carrying on our work. We, too, have had no politics in our commission; our employees have been with us, many of them, all their lives. Ten, fifteen and even twenty years they have served us, and we expect them to serve us as long as they live. They have been efficient men and we do not know or care what their politics are. Politicians have always let us alone; we have not had politics thrust upon us, and we have not in any way courted politics ourselves. We have attended to the propagation of fish, and in working in that way have found ourselves in full sympathy with the efforts of the commissioners on this side of Lake Michigan. We have felt that their policy strengthened ours, and sometimes hoped that our policy on our side of the lake has been of advantage to them when they needed it. And the policy of the fish commissioners, as I have known them in general, seems to have been that of this Fisheries Society, organized for work rather than

for play, organized for business rather than for junketing trips. And so while we have met here, Mr. Toastmaster, and have enjoyed your kind hospitality, and are grateful for all your kindness, we, in some sense, are glad that we could not enjoy it any more, because we feel that we have accomplished in some measure the work which our states have sent us here to do.

Adjourned to meet at Paris, Michigan, next day, Thursday, July 26, 1906, at 11 a. m.

Thursday, July 26, 1906.

Paris, Michigan, July 26, 1906, 11 a. m.

Meeting called to order at the grounds of the State Fish Commission, by the president.

President: If you will come to order we will transact a little business. There is yet some unfinished business and some few reports that have not been made, and I think we will transact the business first. I understand that there are those who desire to ask some questions about this hatchery. If there is time we will take that up after the transaction of business.

The report of the Auditing Committee is now in order.

Mr. Brown: We checked the bills and accounts and certified on the report of the treasurer its correctness.

Report unanimously adopted.

President: We will now hear the report of the Committee on Foreign Relations, Mr. Atkins.

Mr. Atkins: Mr. President and gentlemen, the committee on foreign relations has prepared a report of which I think the volume will be a little too much to read to you now, and I will therefore beg to read the introductory pages and some of the details, and will then file the report.

Mr. Atkins then read the report.

On motion of Mr. Meehan the report was received and accepted.

Report of the Committee on Resolutions by Mr. Whish, chairman.

Mr. Meehan has prepared resolutions of regret on those who have passed away. I suggest that inasmuch as the late Robert Roosevelt was president of the society, more detailed obituary notice be prepared of his death, for next year.

I would like to offer a resolution in this connection relative to the very handsome treatment we have received at the hands of the Sportsmen's Club at Grand Rapids.

Resolved, that the consideration shown to the American Fisheries Society by the people of Grand Rapids, and especially by the Board of Trade, whose commodious meeting room was placed at our disposal, merits hearty thanks, and that the secretary convey the hearty appreciation of the society for courtesies received.

Resolved, that thanks be tendered to the Sportsmen's Club for the handsome entertainment given this society. We found them to be true gentlemen and we congratulate them on their work for the preservation of the fish and game of Michigan.

It has seemed to me that in view of the very remarkable practical work which we have seen of the commission in this state, that something should be said expressing the appreciation of the society, as shown individually and collectively in its discussion of this work.

Resolved, that the visits paid by the American Fisheries Society to the several hatcheries of the Michigan State Fish Commission, disclose how advanced and extensive is their work, and the society congratulate the commission on its position in the front rank of fish culture.

Resolved, that the heartiest thanks of this society are extended to President Joslyn and his associates for their earnest and successful efforts in advancing the interests of this society.

ROBERT BARNWELL ROOSEVELT.

Born, August 7, 1829.
Died, June 14, 1906.

A kindly man who loved the gentle art of angling, and whose interest in his favorite sport led to the first practical work in fish culture in the United States, was Robert B. Roosevelt, once President of the American Fisheries Society. By birth he was a New York City man; by education, a lawyer; by every instinct, a true sportsman. Sometime in the early sixties, generally agreed to be in 1865, while at the annual gathering of the State Sportsmen's Association, he met the famous Seth Green, and a mutual interest in fly casting made them fast and life-long friends. A few years after this meeting Mr. Roosevelt inherited ample means and gave up the practice of the law which he began in 1859, to devote his time to the congenial work of assisting his friend to make trout culture at least a possibility, and to secure adequate laws for game protection. With his aid Green started a little hatchery at Caledonia, in New York state, and here worked out the problem of brook trout culture. The place is now the site of the greatest fish hatchery which the Empire State owns, and is known the world over.

In 1867 Mr. Roosevelt drafted the bill under which the Fisheries Commission of New York state was created and became one of its members. Mr. Green was its superintendent. In 1872, while Mr. Roosevelt was a member of Congress, the bill was passed creating the National Fish Commission, whose work is the greatest in the world. In 1888 he was appointed Minister to the Netherlands and served with honor. Politically, socially and as a sportsman he worked for the general betterment of things as he found them. He was frequently honored by his fellow citizens and was continually an honor to them. As a president of the American Fisheries Society he added much to its efficiency as an organization, and the Society has ordered this page set apart to his memory in its published transactions.

Report unanimously adopted.

President: The chair desires to state that he prepared a notice with reference to Dr. Parker as he was requested to do a year ago. He submitted it however to some of the friends, who desired to make a little revision, and for that reason the obituary notice was not received in time to print in the present proceedings. In view of the great work which Dr. Parker did I still think that a notice of him and his work should appear somewhere in these proceedings and would ask permission to have it sent to the secretary of the society so as to appear in the next year's transactions, if that is agreeable to the society, and unless I hear objection I will take it for granted that it may be done.

President: We will next hear the report of the Committee on Location.

The report was presented by the chairman recommending that Erie, Pennsylvania, be the next place of meeting.

Motion made, seconded and unanimously carried adopting the report.

Mr. Meehan: On behalf of the City of Erie, Pennsylvania, I wish to say that I think the members have chosen wisely, and I am quite satisfied from what I know of the City of Erie, and the people who live there, that the society will have made no mistake in going there. There are many things that will be of distinct advantage to the society. The city is not what you call a large city, having only 62,000 inhabitants, but it has several good hotels, and one in particular which is first class and will house the entire society. The Board of Trade and Chamber of Commerce and one or two of the other prominent concerns in the city will look after our comfort and pleasure and so will the Department of Fisheries of Pennsylvania. There are very large fisheries on the lake and boats will take us to the fishing grounds, and observe the methods of work in Lake Erie and our fisheries rank second on that great lake. There are at least two hatcheries, aside from the one in the City of Erie, which will be of interest probably to the members, one being for trout and the other for bass and lake fishes, and in the City of Erie, there is a little hatchery not supposed to be in operation in July,

being a battery station. You will find two things of interest, one a little frog pond, another an illustration of our work in retaining whitefish in quantities for planting in the lake, after bringing them to fingerling size, to three and four inches. Those who may want to extend their trip a little further, can with readiness, visit some of the other hatcheries in the state; and at that time there will be members of the board and myself who will see that they are attended to any or all of the hatcheries they may wish to visit. There will be many other things of advantage also which I will not enumerate, but keep as pleasant surprises. (Great applause.)

Mr. Fullerton: I desire to offer a resolution regarding the protection of the fish in our Great Lakes.

President: I am under the impression that we adopted something of that kind last year.

Mr. Fullerton: I believe in keeping at it.

President: If the society desires again to go on record as still being firm in the belief, I see no reason why it should not be done.

Mr. Meehan: I introduced a similar resolution myself at the last meeting, as chairman of the committee on resolutions.

President: We adopted a broad resolution last year.

Mr. Fullerton: I believe federal control is our only salvation. We should keep at it eternally. If we had as good protection as we have propagation, there would not be any question about our fish.

Upon motion made, seconded and unanimously carried, the resolution was referred to the committee on resolutions.

Mr. Clark: In view of the excellent reports, so far as we have heard, of the committee on foreign relations and believing that a similar feeling as to its excellence exists on the part of every member, I would move that the same committee on foreign relations be appointed for another year.

Motion seconded and unanimously carried.

President: The committee is continued for another year with the same salary. (Laughter.)

Mr. Fullerton: I move that a vote of thanks of this association be tendered to our retiring president, Mr. Joslyn, for his eminent ability and fairness and for the courtesy extended to each member, during his term of office.

Motion seconded, put by the secretary and unanimously carried.

Mr. Joslyn: I thank you most sincerely for your kind words. I am like the man who had written on his tombstone out west, "He done his damndest—angels could do no more." (Laughter.)

Mr. Seymour Bower: At nearly all annual meetings we have elected one or more honorary members and there is a man in Grand Rapids whose name Mr. Lydell would like to present for that honor.

Mr. Lydell: I offer the name of Mr. Fred J. Adams of Grand Rapids, whose paper is always open to anything we ask for, and who has always been ready to do anything he can for the interest of the fisheries of the United States. He could not be with us today and regrets it.

Motion made, seconded and unanimously carried that the rules be suspended and that the secretary be instructed to cast the unanimous ballot of the society electing Mr. Adams as honorary member.

So done.

President: It was suggested that somebody desired to ask some questions about this hatchery or the mode of conducting it, and if so those questions would be in order now.

(Questions were asked and the subject discussed.)

The committee on resolutions presented the following further report: This resolution was offered by Mr. Fullerton.

Whereas, the members of the American Fisheries Society now assembled at Grand Rapids, Michigan, view with alarm the threatened depletion of whitefish, lake trout and other fishes in the waters and boundary rivers of the Great Lakes;

And whereas, Ontario, to the north of us, advocates, "stopping fishing for five years"; and we do not believe such action will produce the desired results, but on the contrary we believe that lack of uniform laws between Canada and the several states bordering on the Great Lakes, and the lack of concurrent jurisdiction for boundary streams, without enforcement of existing laws, poor protection given during spawning season, and a total disregard of the size of fish caught by fishermen, are at the root of the evil; therefore:

Resolved, That it is the sense of this meeting that Canada and the United States ought to enter into a treaty looking to the control of the fish in our Great Lakes, not only the stocking but the protection.

Resolved further: That there should be federal control of boundary streams, and that the states concerned should cede their rights to the national government.

Resolved further: That we heartily commend the efforts that have been made by the Hon. George Shiras, of the third congressional district of Pennsylvania, looking to federal control, and that we heartily pledge him our undivided support.

Resolved further: That a copy of this resolution be furnished to each of our senators and representatives at Washington, also to each member of the Dominion's House of Parliament.

Motion made, seconded and unanimously carried adopting the resolution.

Secretary Peabody: I have some questions for the question box sent by Mr. John L. Leary, superintendent of the San Marcos, Texas, station, and I will read them and the society can decide whether they wish to answer them, or appoint some one to answer them. It might be well to have these questions published perhaps, with the proper replies.

The secretary then read the questions.

Adjourned sine die.

PART II.

SCIENTIFIC PROCEEDINGS.

ON THE IDENTIFICATION FOR LEGAL PURPOSES OF MUTILATED OR DRESSED SPECIMENS OF WHITEFISH AND HERRING FROM THE GREAT LAKES.*

BY PROF. JACOB REIGHARD OF ANN ARBOR, MICHIGAN.

The statutes of Michigan provide (Act 151, P. A. 1897 Sec. 2.) *"that it shall be unlawful to market or have in possession any whitefish weighing less than two pounds."*

Acting apparently under this statute, the deputy game and fish wardens of Michigan, as I learn from a letter written me by the Michigan State Game and Fish Warden under date of February 8, 1906, have frequently seized fish which they believed to be immature whitefish. On February 8, 1906, the Michigan State Game and Fish Warden sent me samples taken from 18 kegs containing 7,800 pounds of fish seized by his deputies as *"immature whitefish."* Concerning the samples he wrote:

"The fish taken from the kegs, the men from whom they were seized claim are menominee, while all the old fishermen whom we have had examine the same, all the deputies who are to a greater or less extent in the commercial fishing business and are educated in the difference between the commercial fishes known under the Michigan law, pronounce them to be a regular whitefish. What we desire at the present time is expert testimony relative to the fish seized from the fishermen, and have it in such form that it could be readily used as evidence in case a suit was appealed to a higher court, showing the difference between a menominee whitefish and a regular whitefish. A fisherman who had followed the business all his life, or one of our deputies might be well versed and well satisfied in his own mind that he could readily tell the difference between a whitefish and a menominee after the head was removd; however, if a lawyer should ask either of these men to define the difference he would be unable to do so by pointing to any feature or con-

*Contributions from Zoological Laboratory of the University of Michigan, No. 106.

dition of either fish which would differ from the other after the head was removed. I presume you will understand what we desire and if we can get the information in such shape that we can instruct the deputies of this department, it will be a great assistance in enforcing the commercial fishing laws. It is quite an important question in the department at this time and I will be under great obligation to you if you can obtain this information in such form that a person not possessing a mind educated in science may comprehend the difference."

With reference to this letter it may be noted that the term *whitefish* as used in the statute is interpreted by both the game and fish wardens and by the fishermen to mean the true whitefish (Coregonus clupeiformis), though I am not aware that the statute has ever been interpreted by the courts. In order then to secure conviction under the statute, it is necessary to show that the fish in question are true whitefish. If they are not *true whitefish,* it does not matter what they are. It is not necessary to show that they are either menominee, black fins, long jaws or herring. It is not necessary that the game and fish wardens should know how to distinguish between menominees, black fins, long jaws and herring. They need to know merely whitefish from that which is not whitefish.

As the question raised by the State Game and Fish Warden is that of distinguishing between whitefish (Coregonus clupeiformis) and menominee (c. quadrilateralis) it may be assumed provisionally that the question of the separation of the true whitefish from the various other species of whitefish and herring present in the Great Lakes does not arise or presents no difficulties.

I received from the State Game and Fish Warden thirty-five fish which had been cleaned by removal of the head and viscera and then split and salted. These were the fish in dispute. Accompanying them were specimens in the round of whitefish and menominees (Coregonus quadrilateralis). Most of these fish sent in the round reached me in such condition that I could not use them, but by utilizing the collection of the University of Michigan and the markets of Detroit, I had for examination in the round: six menominees from Lake Huron; twenty-two white-

fish, one from Lake Huron, twenty from Lake Erie and one of unknown origin; all of legal weight, i.e. two pounds or over.

It was desired to find some means of separating the whitefish and menominees without using the characters founded on the head or viscera. The characters given by Jordan and Evermann (Fishes of North and Middle America, p. 465) for separating these fishes are based wholly or in part on the head, with the exception of (1) the color, (2) the number of rays in the dorsal and anal fins, and (3) the number of scales in the lateral line and of scale rows above and below it.

The color is so nearly the same in the two species as not to afford a reliable means of separating them. The same remark applies to the fin rays, in which the individual variations of one species overlap those of the other. The number of scales in the lateral line and the number of scale rows was found in the specimens examined to be insufficient in itself to separate the two species, the numbers sometimes coming together or overlapping.

It seemed essential in order to distinguish the whitefish and menominee to make use of some character not hitherto used for this purpose. The structure of the scales as they appear under a magnifying glass was finally made use of. Five to ten scales were removed from each of the fish. In each case the scales were taken from the same place, midway between the first dorsal fin and the lateral line on the left side. In order to clean them they were placed for ten or fifteen minutes in a one per cent. solution of caustic potash and were then rinsed and brushed to remove any shreds of soft tissue that might adhere to them. Thus prepared, the scales of each fish were placed between two slides of clear glass and these were fastened together by pieces of gummed paper.

If any one of the scales thus prepared be examined with a good pocket magnifier giving a magnification of ten to twenty diameters the following points may be readily made out. The outline of the scale is somewhat that of a bent bow with its string. The outline is not straight at any point, but one part of it corresponding to the string of the bow is more nearly straight than any other part. At its middle this part projects into a more or less rounded angle as does the bow string when

pulled back by the hand. At its end it joins the rest of the margin by rather sharp angles which correspond to the points where the bow string is attached to the bow. The portion of the

FIG. 1—Scales of Whitefish (*Coregonus clupeiformis* Mitchill) and Menominee whitefish (*Coregonus quadrilateralis* Richardson), both from Lake Huron. That of the whitefish is at the left. The scales are viewed as transparent objects and are magnified about ten diameters. From a photograph by the writer.

margin of the scale that corresponds to the bow-string is directed towards the head in the natural position of the scale and we may call it the cranial border of the scale. The rest of the margin, corresponding to the bow, forms a continuous and more or less smooth curve, but may be divided into three parts. One of these looks towards the tail in the natural position of the scale and is the caudal border. One is directed towards the back of the fish, the dorsal border, and the other toward the belly, the ventral border.

Somewhere near the center of the scale is a small, smooth area, which represents the center of the original scale of the young fish to which additions have been made from time to time by the growth of the scale. This smooth area may be called the growth center of the scale. Between the growth center and the border are numerous fine striations which form concentric lines parallel to the border and, like the rings in a tree, mark successive stages in the growth of the scale. Running from the growth center to the margin are four radiating ridges which divide the surface of the scale into four triangular areas. Each of these areas is bounded by one of the four borders of the scale and the areas may be called therefore the cranial, caudal, dorsal, and ventral areas. In the natural condition three of these areas, the cranial, dorsal and ventral, are covered by the overlapping of adjacent scales and only one, the caudal, is visible when the scales are in position in the fish.

The characters mentioned as belonging to the typical scales are common to both of the species under discussion but the scales of each species differ from those of the other in certain characters which enable one to distinguish them.

Among the typical scales there are a few in which the central part of the scale is occupied by an irregularly granular area which has a diameter half that of the scale and suggests a greatly enlarged growth center. Scales of this sort were probably formed after the fish had grown to some size and in place of scales that had been lost. They should not be taken into account in attempting to separate species by the scales.

In all the menominees the growth center is in the center of the scale, midway between the cranial and dorsal borders. In all of them the caudal border is strongly crenated (or scalloped)

and from the crenations well marked flutings converge toward the growth center. In all of them the striations on the caudal or exposed area of the scale are much more numerous near the center of the scale than near the caudal border.

On the other hand, in the whitefish the growth center is in 90 per cent. of the fish distinctly behind the geometrical center

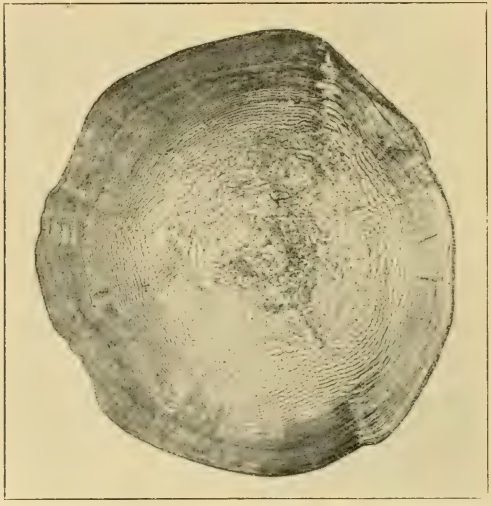


FIG. 2—A typical scale of whitefish (Coregonus clupeiformis Mitchill). This scale is distinguished by its very large, irregular central area. The caudal border is at the left. The scale is viewed as a transparent object and is magnified about ten diameters. From a photograph.

of the scale. The caudal border shows but little trace of crenation and the caudal area but little fluting. Striations of the caudal area are apparently as numerous near the border as at the center of the scale.

The differences between the scales are such that they may be easily distinguished at once by a good hand lens.

Turning now to the salt-fish which were seized as illegal whitefish, we find that in their scale characters (position of the growth center, crenation, fluting, and striation of the caudal area) they agree with the menominees. Twenty-eight of the

thirty-five are wholly typical, i. e., agree with the menominee in all the characters mentioned. Seven (20 per cent.) are not typical in all their characters, but are typical in one or more and are recognizable as menominees. These salt-fish were repre-

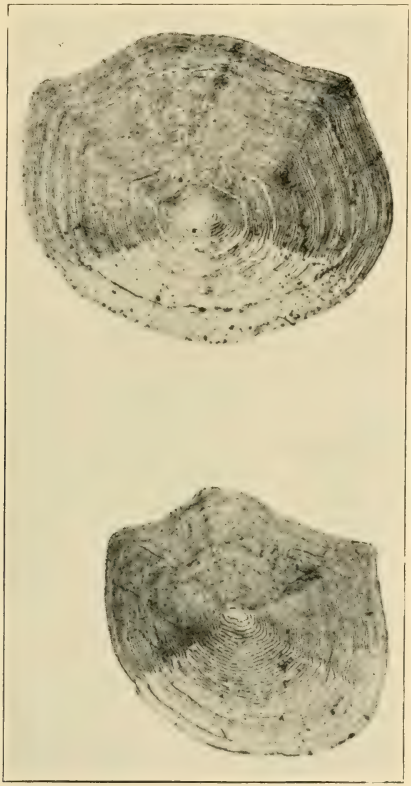


FIG. 3—Scales of Saginaw Bay herring (Argyrosomus artedi Le Sueur) and of the blackfin (Argyrosomus nigripinnis Gill), both from Lake Huron. The herring scale is at the left. The caudal borders of both scales are at the left and both are magnified about ten diameters. From a photograph.

sented by but two samples from a keg. Had more than two fish from a keg been available for examination, it is probable that entirely typical menominees could have been found in each keg.

As a result of this examination the salt fish which had been

seized as immature whitefish were returned to the parties from whom they were taken.

In addition to the whitefish and menominees I have examined in the round eleven Great Lake herring (Argyrosomus artedi), seven from Saginaw Bay and four from Lake Erie, and one blackfin (Argyrosomus nigripinnis), presumably from Lake Huron. The blackfin and the Saginaw Bay herring are distinguishable from the whitefish by the scale characters, position of growth center, and striation of caudal area. The Lake Erie herring were of unusual size, between three and four pounds weight and I am unable to separate them from the whitefish.

In conclusion it may be said that the method employed served its immediate purpose of separating the Lake Huron whitefish and menominees, apparently better than any other method available. Any general statement passed on the data at hand must, however, be regarded tentative. Before the method can be generally employed for separating these two species it is necessary to examine a much larger number of fish than were at my disposal. Perhaps a thousand fish from different localities and of different sizes and selected at random from a much larger number should be examined. If they are found to agree with those already examined the method may thereafter be used with confidence for separating the whitefish and menominees.

It is probable that, the method could be extended to the other species of whitefish and herring in the Great Lakes, but the material at my command is not sufficient to warrant any final statement on that point. If the method can be extended to other fishes it may be made of service not only in enabling determination of imperfect specimens for legal purposes, but in making it possible to identify by the scales the partly digested fish found in the stomachs of other animals. It is often impossible to identify these partly digested fish by the methods now in use. To identify them with certainty would add materially to our knowledge of the food habits of our fishes. Even sould the method not prove to have wide application it may still be of value in the identification of fish remains from a restricted locality. It is to be hoped that some one will take up this suggestion and make an extended microscopical study of the scales of the fishes in some one locality.

DISCUSSION.

Prof. Reighard (during the reading of his paper): In examining scales to distinguish whitefish from menominee, it is necessary to neglect the atypical varieties. There are three characteristics that will enable one to distinguish menominee from whitefish: First, the position of the center; second, the character of the striations on the caudal area; third, the character of the crenations of the border. In some species the growth center is in the center of the scale, and in some it is nearer the caudal border, in others nearer the cranial border. Finally in some species the striations on the caudal area are almost confined to that part of the area which is near the center. That is, we find in some species that these striations extend from the growth center to the edge of the caudal area while in other species they are not equally numerous over the whole of that area. These characters serve to distinguish the whitefish from the menominees. The most striking difference between them is that in the whitefish these striations on the caudal area are close together and cover the whole caudal area; that you can see in the photograph—the caudal area is the lighter one of the two. In the menominee these striations are very numerous in the center and hardly exist near the border. The growth center in the whitefish is nearer the caudal border. The crenations at the edge are practically absent in the whitefish, and the flutings running from the crenations toward the center are also practically absent.

President: Does a difference in the age of the fish make any difference in the character of the scale?

Prof. Reighard: I do not think it does. I do not know from the examination of the scales, but from the fact that the scales grow outward from a center you would expect it to be alike all the way out.

Question. Are there any menominees caught in Lake Erie?

Answer. No—nor blackfins—the only fish of the sub-family there are whitefish and herring.

Mr. Meehan: Whitefish, herring and the jumbo herring.

Mr. Clark: Then I understand that the true whitefish has a smooth border?

Prof. Reighard: Yes sir.

Q. And the menominees have a corrugated border?

Prof. Reighard: Yes sir, as the photographs illustrate.

President: Can you state the relative merits as table fish, of these different specimens?

Prof. Reighard: Of course, the whitefish is more esteemed by the people generally, but these jumbo herring in Lake Erie are being sold as whitefish.

Mr. Meehan: Only to a limited extent.

Prof. Reighard: The longjaw is a good fish.

President: The purpose of the inquiry is to see whether all these different varieties should not be specified in a protective law.

Prof. Reighard: If they were I suppose it would be necessary to specify different sizes as being legal for different species. The whitefish grows larger than any of the others. The minimun size of whitefish which may be taken should be specified; the minimun size of herring, of course, should be less.

Mr. Bean: I want to express my pleasure in hearing this paper of Dr. Reighard's and to say that in my judgment this society and its associates could perform an excellent service for the protection of fishes of all states, by getting into the laws a clear definition of what the fish really are; for instance, take the pike-perch, that is protected in many states during the spawning season. Now there are other fish closely related to the pike-perch, especially the blue pike. Is it the intention of the law to protect that fish or not? In New York the question has come up practically. Seizures have been made of blue pike as being pike-perch. It seems to me that the services of this society and of scientific men generally could very well be lent toward the interpretation, first, and the unifying afterward, of the laws upon the statute books. What I mean is this: You want to

protect the pike-perch. Do you wish to protect only the common glass-eye, wall-eye, or do you mean to protect its allies, many of which are just as good as the common pike-perch? Clearly the intent of the law in New York was to protect the whole genus. Whatever we can do to introduce in to the laws such explanations of the term pike-perch as will lead to the protection of all the fishes of the genus, would be a great gain for the cause.

Mr. Meehan: I fully agree with what Dr. Bean has said. We have had great difficulty in our own state in several particulars—not in reference to the pike-perch, because it happens that in our law we did that—we say pike-perch, wall-eyed pike, commonly known as jack salmon, wall-eyed pike, and blue pike—they are all mentioned separately—but it often happens that in our laws mention is made of a particular species of fish by some common or local name, and there are perhaps two, three or four species, and it makes it a little difficult to understand whether they can be enforced or not. We had one forcible illustration of that in the question of terrapin, in our state, which caused a good deal of laughter and cussing besides. Some gentleman from Pennsylvania introduced a bill into the legislature for the protection of terrapin, a couple of years ago, and before very long the query arose all over the state: Is the snapping turtle to be protected, is the mud turtle to be protected? Because strictly speaking the whole class of terrapin would include those two. Finally we had to go to the attorney-general to get a contorted opinion, so that the snapping turtle should not be protected by the act. Dr. Bean's proposition seems to be sensible and timely.

Mr. Titcomb: I want to concur in what Dr. Bean and Mr. Meehan have said. When I was commissioner in Vermont for twelve years, we had the whitefish protected; but the whitefish in our lakes differed. In Lake Memphramagog as I remember, we had the menominee whitefish, and in another lake we had the labradoricus; and in Lake Champlain we had the true whitefish to some extent. But it was understood that the whitefish was protected as a whitefish. It seems now that we have got to fix our laws so that all these whitefish can be embraced prop-

erly, and it should be so worded that we are not obliged to make ichthyologists out of each one of the commercial fishermen—we have got to get some common names that will identify the different fish properly and have them plainly described in the laws of the different states.

Mr. Seymour Bower: It seems to me a great deal of confusion and uncertainty would be avoided if, whenever a law is enacted for any kind of fish, the scientific name followed the common name. You won't find that in any of our laws, and many cases that have been tried in this state have fallen through because only one of a number of common names was given; and there are a number of local or common names for nearly every kind of fish. Mr. Lydell was a witness in a case which fell through on those very grounds. Certain persons were arrested for catching black bass, and the defense was that they were not black bass, but "river bass"; and the defense made the jury believe it and the case failed. Now if the scientific name had been inserted in the statute they could not have evaded the law on any such pretext as that.

PROTECTION AS AN AID TO PROPAGATION.

BY SAMUEL F. FULLERTON, ST. PAUL, MINNESOTA.

Mr. President and gentlemen of the American Fisheries Society: The subject that I am asked to write a paper on—"Protection"—is so closely allied with "Propagation" that it is a very difficult matter to separate the one from the other; alone either is worthless. Protection is just as essential as propagation if we would reap the benefits from the money and labor expended in the propagation of our fish.

I need not relate what every thinking man knows to be a fact and that is our fish are disappearing from the Great Lakes. Every housewife is reminded of that fact when she calls up the fish dealer, by the *price*—that great barometer of supply and demand.

Now, when the American people are confronted with a problem they naturally ask what is the cause. Are not the waters in the Great Lakes just as pure as they were thirty years ago? No known disease has destroyed these fish. The government has been most liberal and year after year has supplied these waters with millions of fry. Have the States bordering on the Great Lakes, whose duty it is to look after the fish and protect them, done their duty? There is only one answer, an emphatic "No". They have not appreciated the necessity of taking care of that which was intrusted to their keeping for the benefit of all the people.

Efforts from time to time have been made to get the States interested. I have attended three meetings in Chicago, myself, called for the purpose of arousing the States to action. Resolutions were passed and speeches made but the matter ended when the meetings adjourned. There is only one solution—FEDERAL CONTROL.

Now, I do not want to say one word that would in any way detract from the splendid work done by the United States Fish Commission and the different State Fish Hatcheries and the men in charge of same, but I do claim that we do not get the

results we are entitled to from the amount of fry propagated and distributed.

Take for example one United States Station located at Duluth, Minnesota. The amount of whitefish and lake trout fry distributed during the last ten years from that station alone was 228,808,626 (that does not include the blue-fin whitefish, pike-perch and brook trout) and I am positive that nearly all of those young fish were deposited in the Great Lakes; in fact, the great bulk of them went into Lake Superior.

Now, with intelligent planting and proper protection, aided by the natural increase, we ought to have good fishing in Lake Superior. I know the other lakes in the Great Chain have been treated as liberally and they, also, ought to show results. Not only have the Great Lakes suffered by the criminal policy pursued by the States, whose duty it is to protect, but that splendid fish, the shad, is disappearing from the same cause.

Twenty years ago in the city of Duluth, Minnesota, you could get all the whitefish you could carry home with you for five to seven cents per pound. Today you are a lucky purchaser if you get any, but if you do, you will pay from fourteen to seventeen cents per pound and then you will have to be careful that you do not get Winnipeg whitefish instead of the Lake Superior. While the lake trout are not so scarce nor the price so high, they are not by any means so plentiful as they were twenty years ago—all because we have been criminally careless. I just read a dispatch from Ontonagon, Michigan, which I have inserted in this paper and which bears out what I have been saying in regard to the scarcity of the fish in the Great Lakes:

"A large Lake Superior fish company, operating at Ontonagon, has suspended operations for a month in the hope that whitefish and trout then will be found running better. The lifts have been light this season, during the last few weeks especially, and the business has not been profitable. Similar complaint comes from other ports on the south shore of Lake Superior. Poor catches are reported from Marquette and Grand Marais, while instances are noted where commercial fishermen have transferred the scene of their operations to Minnesota waters on the north shore. At Manistique, the Coffey fleet of three tugs has been laid up for the season. The fishing was poor last year and im-

provement was expected this season. But the contrary is the case."

Why, gentlemen, what would you thing of a farmer, who, after carefully attending to his cows all winter, giving them the best of care, when those cows had their young would turn the young out in barren pastures without food, shelter or water; or the poultryman who watches his incubator through the twenty-one days of incubation, after the young were hatched would turn them out to be a prey for hawks, weasels and all other enemies of bird life. You would say that the dairyman and poultryman were crazy. Well, just as crazy things are done in the protection of our fish. The fish culturist selects with care his breeders and after fertilizing the eggs, watches them during the period of time required to hatch, feeds them carefully until the time comes to plant, when they are turned over to the man who distributes, either in a car used for that purpose or in cans. If intended for the Great Lakes, they are placed on a boat running from eight to sixteen miles an hour, dumped from the gangway without any regard to whether the water in that part of the lake is suitable or not. If for the inland lakes, they are taken to the nearest place on the lake from the railroad station and there deposited, regardless—the only condition that there is water.

Why, gentlemen, I have seen twenty cans of pike-perch or wall-eyed pike fry, which were sent by the United States government to a lake in our state, met at the depot by a committee, who with team took them to the lake, only about one-half mile from the village. Instead of taking the fry out in the lake, they dumped the whole twenty cans in a creek that runs under the road which divides the two lakes, where the fry was intended for. That creek was filled with shiner and chub minnows, and the way those minnows went after that pike fry was like a hungry tramp after a pie—"the kind that mother used to make." I don't believe that in one hour there were 1,000 fry left of those twenty cans. The committee who met those fish ought to have had instructions where to plant them and how to plant them. This is not an isolated case, and I have no doubt that the members here present who are engaged in the work have experiences

to relate where fry might better have been dumped in the gutter than taken to the lake or stream.

A short time ago one of our wardens at the city of Minneapolis, Minnesota, seized several barrels of fish, mostly lake trout. They were shipped from a neighboring state to my own. There were over three hundred of those trout that would not average one pound and several that weighed less than one-half pound. Now, what is the use of going to the expense of propagating lake trout and whitefish when fishermen are allowed to catch and sell fish of this size? They don't do it in Minnesota. Our law is 2 pounds undressed, 1½ pounds dressed. After the seizure, I wrote the proper authorities to take the matter up with the shippers, whose cards we took from the package, and offered to go and testify if necessary. So far, nothing has been done that I have heard of, but hope the parties responsible will be brought to trial and a lesson taught them so that in the future they will be good. The great trouble with us as a people, we allow our greed for gold to blind us, but, after the fish have disappeared, then we wake up and do things that should have been done years ago.

In states where separate boards exist, one for the propagation of the fish and another for the protection of the game and fish, the best of harmony does not always prevail between these two boards, but they ought to work hand in hand because to have complete success both must work together. Very often politicians interfere with the work and ruin the labors of the fish culturist. Fortunately, our fish culture work has not been interfered with much by politicians but the protection, which must go hand in hand with propagation, has, and to that extent we have suffered.

REMEDY.

A proper method of distributing the fry. They ought to be placed in the water as near as possible to where the parent fish would select for their spawning ground. A Federal Law and a treaty with the Dominion of Canada, making a uniform closed season on the Great Lakes so as to protect those fish in the spawning season. A license system for all market fishermen and a rigid inspection of their catch. No whitefish or lake trout

allowed on the market in any state less than two pounds undressed. A sufficient number of boats owned by the government of both countries to look after the planting of the fry and see the young are placed in the most natural surroundings. Those boats to patrol the lakes where fishing abounds and their duty to not only see that all fishermen are licensed and that their catch conforms to law but that the exact spawning grounds are located and no fishing allowed thereon, except for propagating purposes. That no fish be taken for their spawn except under the direct supervision of the proper authorities. That no gill nets be allowed during the time fish are taken for their eggs. That all fish not "ripe" or those already spawned be returned to the water with as little injury as possible. That the utmost care be exercised in the selection of the men in charge of those boats. They should be honest, fearless and with ability to enforce the law without fear or favor.

This applies to the Great Lakes or to our commercial fishing but the problem in regard to our inland lakes is just as trying. Care is not taken. When the fry are planted, people are allowed to catch any and all kinds regardless of size. Even the spawning seasons are encroached upon, but especially is this true in regard to our Great Lakes and our only salvation is *federal control*

This Association ought to go on record, not simply pass resolutions (while good in themselves as far as they go) but each state representative should go to his home determined to get congressmen and senators at Washington committed to this proposition. Show them how our fish are disappearing, not through any fault of the propagation but through the poor policy, or no policy, of the states bordering on the Great Lakes. Either put no fish whatever, in these waters, if they are not protected or else change our policy, for I firmly believe that we can never do anything with the individual states. So our only salvation, if we would save our fish, is by the Congress of the United States first making a treaty with Canada, for any scheme that leaves out Canada, as far as the Great Lakes are concerned, would not be feasible. Then after the treaty is made, let the United States, with the co-operation of the Dominion, assume control of not only the propagation but the protection and I predict here before this convention that we can have our old time fishing restored in

the Great Lakes, not only to what it was twenty years ago, but with the added knowledge that has come to the Fish Culturist, an increase of a thousandfold.

DISCUSSION.

Mr. Titcomb: Do I understand from Mr. Fullerton that he does not think the fish distributed in the Great Lakes are properly planted?

Mr. Fullerton: Yes, I do; I said they were not protected.

Mr. Titcomb: Then you had reference to the inland lakes where they are not properly planted.

Mr. Fullerton: I refer to the inland lakes. I do not know very much about the planting of the Great Lakes at all.

Mr. Titcomb: The government gives the fish away and people are furnished with minute instructions as to what to do, but people do not read their instructions. Unqestionably, it would be better if the states and the government could go to the expense of planting those fish themselves in all public waters, but if we plant all the fish in inland waters that are now delivered to applicants, it will probably cost twice as much as it does at present.

Mr. Clark: Ten times as much.

Mr. Lydell: Twenty times as much.

Mr. Clark: Yes, I think it would be twenty times as much.

Mr. Titcomb: Then that means it is prohibitive and you must keep up a campaign of education. The people will learn in time. Federal control is the keynote of protection on all interstate and international waters and until obtained you cannot protect the fish properly. I want to bring up one illustration because the United States Bureau of Fisheries had boasted for years of its great results from the propagation of shad, and for nearly twenty years after such propagation was begun there was a steady increase in the commercial fisheries; during the last four years the commercial shad fisheries have gone down very rapidly; when they go down so fast you may know that the end is coming, just as the Atlantic salmon fishery came to its

end. That is largely due to the fact that with the improved appliances and new methods of pound net fishing, the shad are taken before they get into fresh waters,—they are caught in the lower bays, in salt and brackish waters. States that propagate shad are powerless and the bureau is powerless because we cannot get the fish from which to get the eggs. For instance, at the mouth of the Susquehanna about 8.900,000 eggs were collected this year, where some seasons over 100,000,000 have been taken. That illustrates the conditions, which can only be corrected by federal control.

Mr. Fullerton: That is the only salvation.

Mr. Titcomb: Unless the millenium comes and all states co-operate.

Mr. Fullerton: We will never get it.

Mr. Clark: I rise to disagree with our friend Fullerton in the statement that the fisheries in the Great Lakes are decreasing. I do not believe it at all; the figures will show that in certain localities our fisheries are holding their own, if not increasing.

In regard to the method of control, I do not entirely agree with Mr. Fullerton. However, I not only fully agree with him on the license system, but I went on record regarding this subject thirty years ago, and I have since been much interested in the movement. I would not only have a license system for the lakes, but for the rod, not only to create a revenue but that the offender may be recorded; I would rather have the penalty the revocation of the license than a fine of $25. You revoke a man's license for from one to six months and you have got him. Therefore I am in hearty sympathy with anything of this nature. I think that there should be vigorous and persistent enforcement of the laws regarding the catching of small fish and the pollution of the waters. If the sewage could be kept from the waters we would have a great many more fish. We know of localities where not only the feeding grounds but also the spawning grounds formerly sought by the whitefish have been covered up, thus driving the fish from their natural habitat. The Great Lakes in

many respects do not today begin to compare with what they were thirty or forty years ago.

Mr. Meehan: I must disagree with Mr. Fullerton to some extent with regard to the Great Lakes, at least so for as Lake Erie is concerned. I think that statistics that we have will show that in some particulars there have been actual increases in the fishes. Take the whitefish, for instance: a number of years ago we had a large number of whitefish and then artificial propagation was begun, but just before it was begun the whitefish almost disappeared. They had been caught with all kinds of nets, there was no close season; with the result that it did not pay to put out nets regularly for them. We have given a certain amount of protection, we have a close season, we have certain meshes required, and we have been propagating heavily. This year we have begun to take whitefish again in Lake Erie in quantities. Last Friday for instance, one boat brought in 1,500 pounds, which is a pretty good record for a starter on this work. So the other boats yesterday and the day before came in with good catches of whitefish.

The bluepike have been largely on the increase in the catch and character of the fish for the last six or eight years for us in Lake Erie.

I agree that three-quarters of the fish probably that are planted in our inland waters are not properly planted. Mr. Fullerton says he did not mean the Great Lakes. I think there, as a general rule, they are planted properly, as the states generally do their own planting; but in the interior waters people do not follow the instructions given them.

I agree with what Mr. Titcomb says in regard to the disappearance of the shad. They are falling off rapidly. Our own experience has been that where we used to have 25,000,000 and 30,000,000 eggs a year, this year we only got a little over 3,000,000 in the Delaware river. I think not only are they caught in the bay improperly, but, as possibly Mr. Titcomb does not know, that one or two of the states bordering on the Delaware river, passed laws which cut down the mesh to next to nothing and made the open season for catching the shad throughout the entire year, except two months. The shad can-

not stand that; that alone would have the tendency to destroy the shad fisheries in the river.

We had another drawback this spring in the very cold weather, which probably lessened the shad in our river. It is a very serious matter because not only are the shad decreasing in the Delaware, but I believe also in all the rivers along the Atlantic Coast. Is not that true?

Mr. Titcomb: In North Carolina on the Roanoke River they passed a law prohibiting the use of pound nets in certain parts of the lower bays. As a result the Bureau hatched over 20,000,000 eggs at the Edenton station on the Albemarle Sound the last season, as against an average of from 3,000,000 to 5,000,000 during the years before the law went into effect.

Mr. Meehan: That shows what can be done by proper protection. I think the real solution of the problem lies in federal control. This society passed a resolution last year recommending federal control, and in conformity with that resolution in my report goes the recommendation to the legislature, that Pennsylvania with the concurrence of other states will cede to the United States federal control on the Great Lakes and on rivers of the border states.

Mr. Nevin: For the last two or three years fishermen have told me that they have seen more fish near the surface of the water in Lake Superior than they ever saw before. They have seen schools of whitefish and lake trout so large that they did not think it possible that so many fish were in the lake. There was a time some thirty years ago when there was no more fish caught in the waters of Lake Superior than there have been the past two seasons. The water is so clear that, during the summer months, when there are many nets in the water, the fishermen tell me that they see thousands of fish feed along and pass by the nets. If the fish are coming in full force straight for the net they will rise and go over it. I claim that the fish have seen so much twine in the water that they are becoming educated and keep shy of it when possible. Any fisherman knows that fish do not run into nets during the day time and that there are not many fish caught during calm, still weather; also, they do not catch

as many fish in the light of the moon as they do in the dark. Fishermen tell the same story from the Atlantic to the Pacific.

Mr. Lydell: I would like to talk about seventeen hours on this subject now, but I do not see as there is any use. We are doing the best we can to educate the people as we go along to plant fish right. I know the people of Michigan are getting their instructions with every can of fish we ship to them, and I think most of the people in Michigan know how to plant fish now.

Mr. Gunckel: I remember a few years ago down in Montgomery County, Ohio, several cans of fish were sent to the farmers who planted them in front of their farms in a stream which is high in the spring and lower in the summer. They were planted there in the early part of the season and in the latter part of the summer the hole was dry and the stream was dry. The next year when the rains and freshets came the people asked where the fish were. But there was no water and no fish. That is something that we see all through Ohio. I thing Mr. Fullerton is correct in saying that the people do not use enough care to see that the fish are properly planted, merely sending cans of fish to a committee of farmers or perhaps to a committee of fish-worm anglers; and they distribute them in the little streams in the interior, and never watch them, never see that they are even in deep water. I thing that should be remedied.

While on the floor I wish to ask to be excused. I rode five hours to come here merely to pay my respects to this society and show that I am still a member. I wish to take the next train so that I can go back to my work and not be missed. That is the way a fisherman always does.

President: Of course we will excuse Mr. Gunckel and allow him to go to his work, but he will be missed.

Mr. Boardman: I would like to ask to what extent the pollution of streams affects the propagation and the growth of the fish. I have always considered that the streams of New England which were badly polluted had a bad effect on the fish; but I came from a short trip in Illinois and seeing how badly the water is polluted, and how plentiful the fish are, I have come to the conclusion that pollution of the waters has not so much to do

with the quantity of the fish as some people think. I have changed my opinion, for certainly, in spite of the filthy-looking water the fish are extremely plentiful, and especially in Spring Lake.

Q. They are bass?

A. Large mouth. We always considered factories polluting streams had driven out our bass, but I have changed my opinion, and I would like to know whether I am right in changing it or not.

Mr. Atkins: What polluted the water?

Mr. Boardman: About everything, I should judge. I understand they turn the sewage from Chicago into the Illinois river largely through the drainage canal, and I should think everything that could pollute a stream was there—from the looks of it.

Mr. Atkins: It makes probably an immense difference what sort of pollution you put into the water. It has been found in Europe to be an excellent practice to manure ponds, so that if you have cow-yards and stockyards draining into your streams, according to the practice in many parts of Europe, that would be a decided advantage to the fish.

Mr. Titcomb: What kind of fish?

Mr. Atkins: Carp. (Great laughter.)

And at the same time it might be very deleterious to have the water pollution or refuse from paper mills or chemical works, and it seems to me that the whole question is one that needs to be thoroughly investigated, and we have hardly begun it. There needs to be a commission at work in every state investigating the condition of the water, the causes of any pollution that they may find, and the specific action of the particular sort of pollution upon fishes.

Mr. Clark: A word or two in regard to pollution. The proof seems positive that pollution is highly detrimental to the waters of the Great Lakes for whitefish. At Alpena on Thunder Bay river fifty or sixty years ago, whitefish weighing from 5 to 10 pounds were caught, but twenty-five years ago no whitefish were

taken from the river, nor until within a distance of six or seven miles from its mouth, as can be testified by a gentleman now present (Mr. Wires). Today the men we have there do not see any caught within nine or ten miles of that river, and the bottom of the bay is literally covered with old bark and sawdust. Now, if it was not these polluting substances that came down the river from the mills, that drove the whitefish out, pray tell me what it was. I know there were many caught from the river fifty or sixty years ago, as the evidence is indisputable. If it was not the pollution that drove them out, what was it?

Mr. Nevin: Do coal ashes have any effect?

Mr. Clark: I think any pollution in the water will hurt the whitefish more or less, and there should nothing go in that is in any way harmful.

Mr. Titcomb: This is a subject upon which we could receive testimony continually for a long time. I am sorry that Mr. Marsh is not here from the Bureau, because he has been making some laboratory tests with water taken from sewers and from rivers below the tail-races of mills, and he has by that means discovered the effects of different kinds of pollution. I think that most of the so-called pollution referred to in the Illinois river, is the wash from the farmlands and is not very injurious to fish; and I am told that when the cornfields are overflowed the carp and big mouth bass grow best, and they appear to stand any amount of muddy water. But our pollution in New England is largely from factories in clear water streams, and that stuff kills the fish. On the Delaware river this season I learned that the oil steamers come in at Newcastle, Delaware, in ballast with water; that while it is contrary to law to empty that water out after they arrive at port, they do violate the law, and that water is so polluted that it kills the fish. In the vicinity of the vessel schools of young shad have come up on shore, dead. Near the Du Pont powder works and in other places whole schools are killed by direct pollution in that way.

Mr. Boardman: I have listened to a good many discussions about carp and I asked a commercial fisherman at Spring Lake what he thought about carp, and he said they certainly lessen

the number of other fish, but he thinks that the other fish were afraid of the carp for a while but now they seem to grow together just as other fish do; that the carp do not fight them any more and that the other fish are increasing, and this year their catch has been the best they have had for a number of years, in the vicinity of Spring Lake.

Dr. Bean: I do not like to prolong this discussion, but the subject is one of so great importance to fish culturists that I would like to say just a word. I understand that the paper deals mainly with propagation and protection, but the associated question of pollution is one so near to the results at which the fish culturists aim, that we cannot consider the two without also mentioning the third.

President: That would probably come under the head of protection from pollution anyhow.

Dr. Bean: It appears to me that that is one of the most important subjects with which we have to deal at the present time, not only on the part of the federal and state governments but on the part of the private fish culturist as well. To illustrate how destructive the matter of pollution may become (and the instance which I have in mind is a thing which has been observed in Germany and reported upon by an eminent bacteriologist, Dr. Hofer), I would like to refer to the washings from manure heaps and pig-sties and other domestic arrangements which are turned into streams supplying trout ponds. That kind of pollution, according to the researches of Hofer and others, has caused the disease which we have recognized in our own country only too seriously in fact, as the boil or ulcer disease, especially among the brown trout, and to some extent among the brook trout of this country. Prof. Hofer had brook trout suffering from this disease under observation in Germany, and his paper relates to ulcer disease among brown trout mainly, but also among brook trout. Now this very source of pollution has, in one state, to my own knowledge, reduced the stock of one particular species of trout from some hundreds of thousands to a few thousand in a very short time. It is a very serious matter then for us to consider and I do not believe that it has received the attention from the states and the federal government to which it is entitled, up

to the present day. I do not mean to find fault at all. We have been so busy getting out fish that we have not stopped to think about the enemies and the diseases which retard our work; but we have got to do it now; we cannot afford to lose thousands of dollars worth of stock in a season; and we must all get to work and talk to one another and talk to the people about these things and tell them what to do, if we know anything that can be done, and we do in some cases. I do not wish to take up your time, but I merely wanted to state that it appears to me that Mr. Fullerton's paper starts a subject on which we ought to talk for hours and days, and continue to talk for years to come.

Mr. Clark: In connection with Mr. Fullerton's paper, and to substantiate the statements I have made in regard to the fish and fisheries of the Great Lakes not retrograding, and with due respect and regard to the programme committee, I would like, if it is agreeable to the president and members, to call for a talk and some charts that Mr. Seymour Bower is intending to present. The subject is, I understand, right along the same line with the matter now under discussion.

Mr. Seymour Bower: (Speaking.) A few days ago I had occasion to refer to the statistical records on file at the office of the Michigan Fish Commission, and while delving through these records for certain information, a number of points were developed that it seemed to me would be of interest to the members of this society and worth publishing in the annual report. This is my excuse for appearing before you in connection with a subject that is acknowledged to be pretty dry, the subject of statistics.

For the past fifteen years, or since the beginning of 1891, the Michigan Fish Commission has employed an agent who devotes nearly his entire time to the collection of statistics covering the commercial fishing industry of Michigan waters of the Great Lakes. This agent visits each fishing station at least once every calendar year and collects the figures for the preceding calendar year. The figures are obtained by personal interview and by inspection of the records and books of every fisherman, the latter being thrown open to him freely for this purpose. By reason of this free access to all of the records, and taking into consideration

the personality of our agent, Mr. Moore, who is unusually painstaking and thorough in every detail of his work, we believe that the results obtained are thoroughly reliable, in fact that these statistics are as accurate as it is practical to make them. Realizing that the subject is a pretty dry one, and in order to relieve the monotony somewhat as well as to emphasize comparisons, I have made use of a number of line charts, as I call them.

These tables and charts, then, represent the fisheries data of the Michigan waters of the Great Lakes from 1881 to 1904 inclusive, 1904 being the last year for which we have complete returns, all taken by the same man and without any change whatever in classification.

The figures in detail for whitefish are as follows:

(At the suggestion of Mr. Bower the line charts referred to are omitted from the report, but the detailed figures are given in full.)

WHITEFISH.

Year	Total Catch, Pounds	Total Value
1891	8,110,000	$351,196.00
1892	6,347,000	258,011.00
1893	5,345,000	231,189.00
1894	4,470,000	163,813.00
1895	3,353,000	130,811.00
1896	3,783,000	141,750.00
1897	4,639,000	186,777.00
1898	4,102,000	170,245.00
1899	3,640,000	188,586.00
1900	3,460,000	185,010.00
1901	4,173,000	236,909.00
1902	5,371,000	307,860.00
1903	4,508,000	276,638.00
1904	4,197,000	270,262.00

The first table represents the catch and value of whitefish. All comparisons are made with the year 1891, which I take as my basis of comparison.

In the year 1891 the total catch of whitefish was 8,110,000 pounds—this refers only to Michigan waters of the Great Lakes—of a total value of $351,196. That is the high year. The catch has not been as great as that in any year since. It fell off rapidly until 1895, which is the low year, not only in the catch, but in

the value of the fish. From that time on the catch has increased as a whole until the total of the last three years of the period ending with 1904 was 2,800,000 pounds more than for the preceding three years, and for the last five years it was over 2,000,000 pounds greater than for the preceding five years.

The values have increased faster in recent years than the catch. The total value for 1902 was nearly equal to that of 1891, although the catch was considerably less. The claim that whitefish have been nearly all cleaned out of the lakes is not true, at least so far as Michigan waters are concerned. The catch has held up well for ten years while for the last three years a marked increase is shown.

Mr. Fullerton: Can you assign any cause for the increase in price?

Mr. Bower: Everything has increased in price; meats, for instance, and nearly all food staples. Moreover the producing area for fish remains stationary, while in good times the demand increases with the increase in population. Going back a little, however, we find an exception to the rule. Ordinarily when any commodity is scarce on the market the price is enhanced, but we find that in some of the years in which we had the smallest catch of whitefish the price was lowest per pound. It seems that for some reason or other—perhaps on account of "hard times"—the price affected production rather than production the price. In other words, values were so low that fishing was more or less unprofitable.

Secretary Peabody: Was not that because the Lake Superior whitefish was not educated in those years?

(Laughter.)

Mr. Bower: Possibly, but the exception applies not to whitefish alone, for the years 1895 to 1897 were the low years with all kinds of fish, not only in catch but in value. Beginning in the late 90's, however, there was a gradual increase in the total value of the catch of nearly all kinds, a conspicuous exception, however, being the sturgeon.

The next table refers to lake trout.

LAKE TROUT.

Year	Total Catch, Pounds	Total Value
1891	9,132,000	$375,200.00
1892	8,860,000	358,598.00
1893	8,948,000	366,489.00
1894	7,291,000	243,261.00
1895	6,293,000	234,311.00
1896	6,900,000	240,902.00
1897	6,580,000	246,121.00
1898	6,495,000	235,915.00
1899	6,505,000	292,852.00
1900	6,458,000	282,711.00
1901	7,388,000	337,872.00
1902	9,363,000	431,630.00
1903	9,635,000	463,690.00
1904	11,638,000	504,696.00

You will notice that 1895 was the low year both in catch and value of lake trout. Then the catch held its own pretty well until 1900, increasing from that time to 1904, when not only the catch but the value was greater than for any year of the fourteen-year period, and probably greater than at any time in the history of commercial fishing in Michigan.

We account for the increase in catch of lake trout to some extent by the increased amount of fishing in deep water for siscowet trout in Lake Superior, which is rather expensive and when prices are low rather unprofitable.

Mr. Clark: I would like to ask, Mr. Bower, if this increase is not due in a measure to the increased output of fry, more particularly of the United States hatcheries as well as from Wisconsin,—the output being greater in recent years.

Mr. Bower: I have no doubt that the increased output of the hatcheries is also an important factor in the increased catch.

Mr. Clark: An increase of 50 per cent. at least or more than that.

Mr. Bower: The figures in detail of the herring catch and value are as follows:

HERRING.

Year	Total Catch, Pounds	Total Value
1891	7,823,000	$117,319.00
1892	5,564,000	71,979.00
1893	10,178,000	159,313.00
1894	8,825,000	112,046.00
1895	10,512,000	101,618.00
1896	12,115,000	92,012.00
1897	12,958,000	98,510.00
1898	14,937,000	143,439.00
1899	17,567,000	193,000.00
1900	13,068,000	172,250.00
1901	14,865,000	287,850.00
1902	19,112,000	285,875.00
1903	15,767,000	305,036.00
1904	19,927,000	332,831.00

Nineteen hundred and two was the low year; then the catch fluctuated, but you will notice that in some years when the catch was low the price was even still lower proportionately. Very likely, however, the fish were just as abundant as they were in later years. The small catch does not necessarily indicate scarcity but rather that the price was so low that it was unprofitable to fish for them in some localities. Then you will see that the catch increases rapidly down to 1904, when it was the largest in the history of commercial fishing in Michigan, not only in pounds but in value,—nearly three times as large as it was in 1891.

Mr. O'Brien: Are not the meshes of nets now used smaller than they were in nets used in 1891?

Mr. Bower: They are for Green Bay, but elsewhere the sizes are the same as they have been as far back as 1889, except from 1897 to 1899. In 1897 our general law on meshes was so amended as to increase the size of large meshed pound nets one-half inch and large meshed gill-nets one-fourth inch, but this amendment was repealed two years later, in 1899, leaving the sizes the same as since 1899, except for Green Bay.

Mr. Nevin: How was the fishing reported on Lake Michigan this year?

Mr. Bower: I have not heard.

President: Is not there a greater demand for herring than there was fifteen years ago?

Mr. Bower: There is a greater demand for all kinds of fish.

The next table shows the catch and value of pike-perch or wall-eyed pike.

PIKE-PERCH OR WALL-EYED PIKE.

Year	Total Catch, Pounds	Total Value
1891	2,791,000	$92,623.00
1892	2,356,000	84,285.00
1893	1,861,000	76,717.00
1894	2,824,000	75,056.00
1895	2,134,000	59,845.00
1896	2,121,000	69,106.00
1897	2,432,000	82,982.00
1898	3,113,000	98,356.00
1899	2,816,000	115,176.00
1900	1,741,000	82,927.00
1901	1,713,000	87,412.00
1902	2,289,000	129,540.00
1903	2,904,000	174,609.00
1904	2,697,000	168,306.00

Although there was a general slump in values in the middle 90's, the catch of pike-perch fluctuated less perhaps than most of the other kinds. You will notice for the year 1903 the total catch was the largest in any of the fourteen years with one exception; and the values of 1902, 1903 and 1904 are much greater than for any similar period of the fourteen years.

The next table represents the common or yellow perch.

PERCH.

Year	Total Catch, Pounds	Total Value
1891	2,017,000	$21,192.00
1892	2,560,000	28,758.00
1893	2,622,000	30,374.00
1894	2,785,000	27,435.00
1895	2,437,000	25,093.00
1896	2,010,000	19,393.00

Year	Total Catch, Pounds	Total Value
1897	2,091,000	25,173.00
1898	2,772,000	34,192.00
1899	3,458,000	41,473.00
1900	4,031,000	48,202.00
1901	4,155,000	62,422.00
1902	3,300,000	63,622.00
1903	3,107,000	73,292.00
1904	2,474,000	59,421.00

You will notice that 1896 was the low year for both catch and value, also that during the last five or six years both catch and value are quite largely increased. This increase in the catch of perch, also of suckers and some other kinds of rough fish, is due to some extent to the introduction of submarine trap-nets about eight years ago, the use of which was abolished in this state beginning with January 1, 1905. From 800 to 1,000 of these nets were employed at that time.

Mr. titcomb: Do you propagate perch now?

Mr. Bower: No sir; not the common perch.

Mr. Titcomb: Do you believe it ought to be?

Mr. Bower: If it is a practical success, yes, sir.

Mr. Titcomb: It is one of the easiest fish to propagate we have.

Mr. Meehan: We propagated 62,000,000 this year.

Mr. Clark: This was the white perch?

Mr. Meehan: No, the yellow.

Mr. Bower: The next table refers to suckers.

SUCKERS.

Year	Total Catch, Pounds	Total Value
1891	1,392,000	$17,132.00
1892	2,352,000	27,701.00
1893	3,114,000	32,670.00
1894	3,600,000	34,054.00
1895	3,900,000	35,035.00
1896	1,900,000	20,067.00
1897	2,162,000	24,428.00
1898	1,833,000	21,183.00
1899	2,017,000	27,075.00

Year	Total Catch, Pounds	Total Value
1900	2,650,000	34,167.00
1901	2,751,000	47,665.00
1902	3,925,000	68,714.00
1903	5,432,000	99,061.00
1904	5,000,000	81,814.00

You will notice that the crop of suckers in Michigan in 1903 and 1904 was very large—must have been more than one born a minute. (Laughter.) Suckers were probably as abundant in 1891 as now, but their value at that time was much lower, hence there was less incentive for catching them. If the law prohibiting the use of submarine trap-nets has been enforced since it took effect, January 1, 1905, the catch of suckers and other coarse fish will probably show a considerable decrease since then.

Q. Is not the sucker leading the whitefish now?

Mr. Bower: Yes, in pounds but, of course, not in value.

Speaking of values I want to say that those I have used in all the tables are the prices received by the fishermen. In case a fisherman is also a dealer his fish are valued at what he would pay somebody else for them and not what he actually receives as a dealer. The values are on the lowest basis, the price received at first hand.

The price and value of sturgeon, including caviar, are as follows:

STURGEON.

Year	Total Catch, Pounds	Total Value, Including Caviar
1891	831,000	$47,571.00
1892	501,000	31,817.00
1893	468,000	28,758.00
1894	294,000	17,733.00
1895	225,000	16,712.00
1896	225,000	17,483.00
1897	185,000	19,303.00
1898	237,000	25,931.00
1899	217,000	33,492.00
1900	176,000	24,847.00
1901	132,000	20,697.00
1902	107,000	17,814.00
1903	110,000	18,360.00
1904	101,000	16,800.00

It will be noticed that the sturgeon is rapidly on the road towards practical extermination.

Mr. Clark: It is practically gone.

Mr. Bower: You will also notice that values have increased much faster relatively than the catch. This is due in a great measure to the increase in the value of caviar at first hands; nearly every man that catches sturgeon now-a-days knows how to make his own caviar, and he does so. Although the process is simple and inexpensive, only a few understood it a number of years ago—it was carefully guarded as a trade secret. Fishermen used to receive 15 to 20 cents per pound for the roe whereas now they realize 80 cents to $1.00 per pound for the caviar. The output of caviar in this state in 1891 was about 60,000 pounds, but in 1904 it had dropped to about 8,000 pounds.

The next table covers all kinds of fish not previously classified.

ALL OTHER KINDS, PRINCIPALLY GERMAN CARP, MENOMINEE WHITEFISH, CATFISH, BULLHEADS, SUNFISH, ROCK BASS, GRASS PIKE, SAUGERS, ETC.

Year	Total Catch, Pounds	Total Value
1891	1,557,000	$35,790.00
1892	2,795,000	72,434.00
1893	1,482,000	38,265.00
1894	1,234,000	29,965.00
1895	1,277,000	24,165.00
1896	1,301,000	30,188.00
1897	1,510,000	26,536.00
1898	1,671,000	30,816.00
1899	2,081,000	44,795.00
1900	2,400,000	50,798.00
1901	3,061,000	52,005.00
1902	2,763,000	55,665.00
1903	2,384,000	56,202.00
1904	1,971,000	48,860.00

You will notice the same general condition with reference to the catch of these miscellaneous fish, viz: low in the middle 90's, then gradually increasing. The catch, however, decreased somewhat in the last year or two, during which time probably 50 to 60 per cent. of this class was German carp.

The aggregate catch and value of all kinds of fish are shown in the next table.

TOTALS OF ALL KINDS.

Year	Total Catch, Pounds	Total Value
1891	33,643,000	$1,058,028.00
1892	31,345,000	933,586.00
1893	34,018,000	963,778.00
1894	31,323,000	703,365.00
1895	30,131,000	627,594.00
1896	30,355,000	630,902.00
1897	32,557,000	709,831.00
1898	35,194,000	760,079.00
1899	38,432,000	936,453.00
1900	34,011,000	881,002.00
1901	38,259,000	1,133,839.00
1902	46,242,000	1,461,724.00
1903	43,857,000	1,467,520.00
1904	47,992,000	1,482,990.00

You will see that the combined catch was low in 1894, 1895 and 1896, with the lowest value in 1895, and that is true of nearly all kinds of fish. Then there was a gradual increase until the year 1904 when the total both in catch and value was the highest of any year of the fourteen-year period, and probably higher than at any time since commercial fishing has been carried on in this state.

The next table shows in detail the data with reference to pound-nets.

POUND-NETS.

(Includes trap-nets, fyke-nets, gobblers, and submarine trap-nets, or all forms of nets that take fish by leading them into trap or pound.)

	Total Length of Leader in Fathoms
1891	304,000
1892	245,000
1893	237,000
1894	242,000
1895	210,000
1896	213,000
1897	269,000
1898	268,000
1899	290,000
1900	305,000

	Total Length of Leader in Fathoms
1901	282,000
1902	305,000
1903	341,000
1904	345,000

For a few years after 1891 the use of pound-nets gradually dropped off. The low years were 1895 and 1896, then there was a grandual increase, amounting to 12 per cent. in 1904 over 1891. Probably this increase has been lost by this time, if the law prohibiting the use of submarine trap-nets, effective January 1, 1905, is enforced.

The next table refers to gill-nets.

GILL-NETS.

	Fathoms in Length	Miles
1891	2,363,000	2685.2
1892	2,503,000	2844.3
1893	2,815,000	3198.8
1894	2,795,000	3171.6
1895	2,616,000	2972.7
1896	2,410,000	2738.6
1897	2,456,000	2790.9
1898	2,687,000	3053.4
1899	2,802,000	3184.0
1900	3,051,000	3467.0
1901	3,652,000	4147.7
1902	4,032,000	4581.8
1903	4,213,000	4787.5
1904	4,510,000	5126.1

The use of gill-nets has increased much more rapidly than any other form of apparatus. In no later year has there been a less number of these nets in use than in 1891, and in the last four years there has been a large increase, amounting to nearly 100 per cent. in 1904 over 1891.

The next table refers to seines, the use of which is relatively unimportant.

SEINES.

	Fathoms in Length
1901	8,200
1892	19,800
1893	27,500
1894	35,800

	Fathoms in Length
1895	26,300
1896	22,000
1897	19,000
1898	4,800
1899	5,100
1900	3,700
1901	4,400
1902	4,500
1903	4,800
1904	6,200

The next and last table shows the total investment in lands, buildings, apparatus, etc., for the fourteen-year term.

TOTAL VALUE OF FISHERY LANDS AND BUILDINGS AND ALL FISHING APPARATUS, INCLUDING NETS AND BOATS.

1891	$1,105,000
1892	1,169,000
1893	1,315,000
1894	1,200,000
1895	1,078,000
1896	1,010,000
1897	1,022,000
1898	1,181,000
1899	1,253,000
1900	1,237,000
1901	1,467,000
1902	1,670,000
1903	1,946,000
1904	2,175,000

The general depression in the fishing industry during the middle 90's is shown in this table as well as in the catch, the low years being 1895 to 1897, the figures then increasing until the total value in 1904 is more than double that of 1896.

The total number of men employed increased from about 4,000 in 1891 to about 7,000 in 1904. (Applause.)

Mr. Fullerton: I am delighted to know that we do not need any change in our fishing laws, as the fish are increasing so fast! I am tickled to death to think that our fish are increasing so rapidly as they are! It is gratifying to me to learn that the information that I have been getting from the market fishermen and other people is inaccurate.

Mr. Clark: The increase to a certain extent has been by protection and propagation, and we want to continue it still more thoroughly.

Mr. Brown: Right in this line I want to say that during the last session of the legislature of Michigan we read some of these figures to show the members the importance of the work, the number of people that were employed in the business and the amount of capital invested, and some of the members asked us about the statistics of other states, and we had none. The United States takes them only once in five years and we were criticised for making our own statistics. Now I want to ask if the members do not think that the same sort of statistics and the same methods from all other states would be valuable and help the fishing interests generally. Mr. Fullerton I think, overlooked in his remarks the large increase in the amount of nets and seines that are in use now as compared with a few years since.

Mr. Fullerton: I took that into consideration.

Mr. Brown: And the large increase in the price. I want to speak also about sewage and its relation to pollution of waters. Take the Saginaw river between Bay City and Saginaw where all the ordinary sewage of the city runs into the river, there was never any notice of the stream being depleted until they begun to turn the beet sugar factory waste in, which contains sulphuric acid, lime, etc., and that surely killed the fish. But between November and March of every winter they fish with nets; and in that thirteen miles of river in 1904 the catch was 1,600,000 pounds, of which 535,000 pounds was perch, 777,000 suckers, and then some bass and sunfish, 122,000 pounds, and of course this shows that it is not all pollution that makes a very marked difference in the catch, particularly in the case of rough fish.

Dr. Birge: I should like to call attention to the point that Mr. Brown mentioned, that of the increase in the nets. I wish that Mr. Bower, if he could find time to do so, would prepare a correlation table showing the ratio between some unit of net pounds or whatever he may select, to the amount of fish caught in that year. It seems to me that the showing would be more favorable for the fish than I had anticipated. The pound nets

show apparently considerable increase; the gill nets show an increase of about 80 per cent., as I figure it roughly. The total catch of the fish showed an increase of about 50 per cent. over 1891. Those figures, of course, I want to verify. Now, if one important method of catching did not increase and the other increase was about 80 per cent., in the second important method, then it would seem that the fish are not much less abundant in the lakes now than in 1891—somewhat less abundant. but not greatly so. One who is familiar with the statistics could undoubtedly work out a much closer correlation, and show the significence of these figures as bearing on the relative abundance of these fish at the stations fished by the Michigan fishermen fifteen years ago and at present.

President: I think that all these figures and suggestions lead to this conclusion, especially in view of what has been done in the several states in the way of protection, that there is an increase of fish in the lakes. But if you turn to the protective laws in the several states, while they were in existence in 1891, they were not enforced as well as they are today. Now, I know that Michigan has done better in the last six years than ever before, and I think it is true to a considerable extent in the other states; and therefore if I am right about that it rather strengthens the argument of Mr. Fullerton, that if we would put it under a uniform system, such as federal control, the protection would be far more effective and far more useful than now. But I think that some of these results shown by the chart are due to the protective measures that have already been taken.

Mr. Nevin: Is the two pound lake trout law enforced in Michigan in regard to the protection of the small fish?

President: I don't know.

Mr. Nevin: I know it is not in our state.

Mr. Clark: It is in force in Michigan. The lake trout law is enforced just as well as the whitefish law.

Mr. Seymour Bower: In regard to the immature whitefish our statistical agent is very familiar with the grounds in Michigan; knows just what kind of fish are caught and how they are

caught at every point along our coast line. According to his estimate there are twice as many illegal whitefish caught in Michigan waters today, in number, I mean, as there are legal whitefish —in other words, two-thirds in number of the catch of whitefish today in Michigan waters are illegal fish—and that very materially reduces the weight and value, because most of those fish are salted. As an illustration, last week our agent, while in Toledo, called at a fish house and while there they received a little consignment of whitefish from a village on the east shore of Lake Michigan. It was a small lot, 800 pounds, but there were between 1600 and 1700 fish by count. The shipper received three cents a pound, whereas for a four, or five or six pound fish the price would have been ten or twelve cents a pound. The great curse in the whitefish industry is the catching of the small fish. If that had been checked in the last ten years, the lines on my chart would not go clear beyond the paper. There is not a single commercial fish caught in Michigan where there is so great a percentage of immature, illegal fish taken as the whitefish. The great bulk of over 90 per cent. of the lake trout caught in this state are of legal size according to our agent. But two-thirds of the whitefish by number are illegal fish.

President: Of course, I did not mean that this increase was due to protection alone; but it was taken in connection with the work being done in propagation as well. There isn't any doubt but that the work of propagating whitefish in the last few years has done a great amount of good. We all know around here in Michigan at least, that whitefish have begun to appear where they had disappeared because they had been cleaned out by the net

SOME EXPERIMENTS IN THE PROPAGATION OF RAINBOW TROUT.

BY MR. ALBERT ROSENBERG OF KALAMAZOO, MICHIGAN.

In presenting this paper for your consideration, I feel somewhat diffident, as I have no means of knowing that there is anything new or original in it.

In view, however, of the discouraging work with these fish at other stations as well as ours, and the radical and gratifying results obtained by these experiments, it will, no doubt, prove interesting to those fish culturists engaged in this work.

If you will pardon the digression, I will begin by giving you a short resume of the season of 1904, so that a comparison may be made:

Our take of eggs was	252,000
Loss of eggs was	95,000
Loss of Alevins	81,840
Loss of fry	11,262

The eggs were taken at side of pond, regardless of air temperature, using double pan; lower one containing water. When separated, they were carried in pails to the hatchery, washed, measured, and placed on trays.

When hatching was thoroughly started, alevins were taken up and placed in fish trays. Here they commenced to die in large numbers, when from one to four days old; and all fish culturists, who have had similar experiences can realize the awfulness of picking dead alevins, bursted sacs, etc.

We tried leaving them in tank where they were hatched; but the result was the same—the losses ran from 5 per cent to 100 per cent in different lots of eggs.

The next serious, and to me, new feature, occurred when the sac was nearly absorbed, and the fish were turned out in a tank preparatory to feeding. The little fellows scattered all over and lay on their sides gasping—only a few swimming naturally. For want of a better name, we christened these "side-wheelers." The losses in batches affected in this way ran about 90 per cent.,

and, strange to say, the best looking fish were attacked in this way.

As we are producing these fish for commercial purposes, a very serious condition confronted us.

I attributed these discouraging results to the following causes:

Loss of eggs caused by chilling.

Low quality of eggs and fish caused by over feeding stock fish and the nature of their food.

Acting on these theories I took particular pains in the summer of 1904 in the feeding of our stock fish. Having fed hog plucks to our fish, giving the large fish mostly lights, I shifted to sheep plucks, and now use them exclusively. Hog plucks contain too much grease, oil, etc. I also fed minnows, grasshoppers, worms, etc.

As soon as we got through handling brook trout during the fall of 1904, we moved our rainbow stock fish to the breeding pens. In looking over the fish at this time (12-20-'04) found one ripe female, which with a few males I took into the hatchery. Pond water was displaced by using hatchery water, temp. 49. After leaving the fish in the warmer water a few minutes, we stripped the female. This was unusually early for us to get any rainbow eggs, and as we got a few eggs during the month of January, it was an easy matter to follow the development. When the first lot of eggs eyed they were counted and dead ones subtracted, showing 96 per cent fertile eggs. This result was practically kept up with—

Our entire take, which was	469,000
Our loss of eggs was	45,000
Our loss of alevins was	106,313
Our loss of fry was	13,408

Whilst the loss in alevins was still very heavy, we had only two small lots of side-wheelers, and the losses from this cause was small. Eggs taken during the last ten days of the season were taken at the side of pond, weather and water being fine; nevertheless losses in these eggs were heavy, and alevins almost a total loss. Not having any idea of writing this paper at that time I did not keep a separate record of those eggs.

Whilst this was a great improvement, I believed we could get still better results; especially with alevins, and herewith give you results of this season's work:

Take of eggs	561,500
Loss of eggs	57,200
Eggs shipped out	292,000
Loss of alevins	32,603
Loss of fry	12,360

We had no side-wheelers; all eggs were taken indoors, after the fish had been admitted to the warmer water.

In conclusion I will give you record of eggs taken February 5, 1906:

Air temperature, 4 degrees above zero.
Water of pond, 36;
Water of hatchery, 48;
Amount of eggs taken, 187 liquid ounces;
Amount of eggs after eying, 211 liquid ounces.

Our stock fish will not run up a raceway, and we resort to netting them once a week in the early part of the season, and twice a week in February and March.

Out of 230 fish stripped this season, only nine females entered raceway, although water supply is ample.

DISCUSSION.

Mr. F. R. Bassett: I find that they are having more and more difficulty in getting brook trout up to 12 or 15 months old than after that.

From some cause, our greater loss is in fish between one and two inches in length. After they reach two and a half inches in length we seem to have no difficulty whatever in raising them.

Mr. Clark: At Northville reverse conditions prevail. We have no trouble in raising them from one to two inches long; the difficulty is after that. I think that it might be well to work on a co-operative plan. We will grow them at Northville up to one and one half or two inches and let you people raise them after that. (Laughter.)

Mr. Seymour Bower: We will have to form a trust.

Mr. Clark: At Northville when the fish are about two inches in length there is a period of heavy loss, and again when they are a year or a year and a half old we have difficulty with the bacterial disease that was, I believe, originally brought to notice at Northville.

Dr. Bean: And a great many other places.

Mr. Clark: In raising brook trout up to an inch and a half or two inches we have but little trouble. Of course we do not have any difficulty raising the rainbow trout up to four or five inches.

Mr. Nevin: Our trouble in Madison is to raise the trout up to two inches long.

FISHERY LEGISLATION BEFORE THE FIFTY-NINTH CONGRESS, FIRST SESSION.

BY HUGH M. SMITH, DEPUTY UNITED STATES COMMISSIONER OF FISHERIES.

The Congress whose first session was concluded on June 30, 1906, had before it an unusually large number of measures affecting the fishing industry and fish-culture; some of the most important of these were enacted into law, others were favorably reported by committee but failed to secure consideration, while others did not get beyond the door of the committee room.

The personnel of the committees which passed upon fishery legislation in the Fifty-third Congress—the committee on fisheries of the Senate, the committee on the merchant marine and fisheries in the House—included some of the ablest men in both houses. Certain fishery legislation was also considered by the committees on foreign affairs and territories.

All bills affecting fishery matters or relating in any way to the fishery work of the government are referred by the committees to the Secretary of Commerce and Labor and by him sent to the Commissioner of Fisheries for a written report or statement of the position of the government as to the merits of the proposed legislation. Later, public hearings may be held, and the Commissioner or a representative of the Bureau of Fisheries may appear before the respective committees and give testimony or make argument.

It has not often happened that Congress has undertaken to regulate fisheries on the high seas or on the coasts of the states. One of the most conspicuous examples of such legislation was the so-called close time mackerel law, enacted in 1887, expiring by limitation in 1893, and having for its ostensible object the protection of the mackerel *(Scomber scombrus)* during the spawning season. This bill prevented the capture of mackerel by American vessels prior to June 1st of each year, and had the effect of wiping out the southern spring mackerel fishery which

had been prosecuted for many years. As I have elsewhere pointed out*, this legislation could have and did have no appreciable influence on the supply of mackerel, and it is, of course, well known to the members of this Society that the five years of assumed protection were immediately followed by the most marked and long-continued period of scarcity in the history of this fish on the American coast.

I bring up this subject at this time because of the method adopted by Congress to attain the ends sought—a method followed by the last Congress in fishery legislation of an entirely different nature. It is worthy of remark that Congress did not attempt to assume any jurisdiction over the time or manner of fishing for mackerel on the high seas, or within the three-mile limit, or in state waters, and thus avoided an important constitutional question, but it accomplished the same thing through the customs service—that is, it prohibited the landing on the United States coast of mackerel caught during the interdicted period.

Entirely similar legislation was addressed to the sponge fishery by the fifty-ninth Congress. The recent advent on the Florida coast of more than a thousand Greeks engaged in taking sponges by means of diving apparatus—a method prohibited by the Florida statutes—aroused the native sponge fishermen to a high pitch of excitement, and resulted in bringing the question to the attention of Congress, inasmuch as the state found itself powerless to cope with the situation, as the Greek divers plied their trade in waters beyond control of the state and also beyond governmental jurisdiction—that is, beyond a marine league from the shore. After a number of hearings, at which the views of sponge hookers, the Greek divers, and the Bureau of Fisheries were presented, a compromise measure, framed on lines suggested by the bureau, was agreed upon and beame a law on June 20, 1906. The principal features of this bill, which goes into effect May 1, 1907, are: (1) no sponges taken with diving apparatus in the Gulf of Mexico or Straits of Florida shall be landed, delivered, cured, or offered for sale at any port or place in the United States, with the exception that sponges so taken in water

*The Southern Spring Mackerel Fishery of the United States, by Hugh M. Smith. Bulletin U. S. Fish Commission, 1898, pp. 193-271.

more than 50 feet deep between October 1 and May 1 of each year are exempt from the provisions of the act; (2) no sponges from said waters having a smaller maximum diameter than four inches shall be landed, delivered, cured, or offered for sale at any port or place in the United States; (3) the Secretary of Commerce and Labor is directed to enforce the act, and is authorized to call on the vessels of the navy and revenue-cutter service to assist therein.

Two bills designed to prevent citizens of other countries from engaging in the fisheries of the United States were under consideration but only one was passed. It applies to the waters of Alaska, and is particularly aimed at Japanese fishermen who, for several years, have been visiting the Alaskan coast in their vessels and making large catches of salmon and other fish. The report of the House committee on territories stated that the proposed legislation was "not by reason of the existence in the United States of any feeling of hostility toward the Japanese people, but because of the proximity of Japan to Alaska the Japanese fishermen fish more in Alaskan waters than all other aliens combined," and the committee pointed out that Attu, the most western of the Alaskan islands, is 900 miles nearer to Tokyo than it is to San Francisco. The other measure, prohibiting aliens from gathering sponges within one marine league of the United States coasts, was directed against the Greeks who have recently gone to Florida in overwhelming numbers and engaged in the sponge fishery with diving apparatus. Unfortunately this fishery is not susceptible of regulation in this way, as the entire catch is made beyond the three-mile limit. The bill, if it becomes a law, will have the effect of preventing the Greeks from engaging in the sponge fishery among the Florida keys, and, taken in conjunction with the other restrictive sponge legislation, may aid in curtailing the ravages of our sponge grounds.

After a struggle extending over many years, public sentiment in Maryland secured the enactment by the last legislature of a general law sanctioning the rental of bottoms for purposes of oyster culture. The law establishes a shellfish commission, and invites the co-operation of the United States Coast Survey and Bureau of Fisheries with the state in determining and defining the natural oyster bars. In order to give full force to this

feature of the Maryland statute, Congress passed an act authorizing the desired co-operation of the two bureaus in question with the Maryland shellfish commission and appropriating $15,000 to cover the expenses of the government work in connection therewith. This state and federal legislation means a great deal to the oyster industry of Maryland and to the large number of people who are fortunate enough to come within the effective range of the Chesapeake oyster; and a very marked increase in the oyster crop of the state may be expected in a few years.

Undoubtedly the most important fishery legislation considered and enacted by the Congress in question was that pertaining to the fisheries of Alaska, which, being an unorganized territory, is entirely under the control of Congress. The new legislation is a recognition of new conditions, and is a response to a very general demand for adequate protection for the vast fishery interests of our arctic province, particularly the salmon. The new fishery code for Alaska was formulated after extended hearings before the House committee on territories, and is acceptable to those engaged in the fishing industry as well as to the government. The act, which became a law June 26, 1906, and is immediately effective, "designed to reenact and harmonize many provisions of existing laws relating to Alaskan fisheries; to enlarge and extend the scope of restrictive features on fishing, and to include such further provisions for protection and regulation as are deemed essential to preserve and perpetuate the fisheries and to increase the natural supply by artificial propagation."

The leading features of the law are a tax on the products canned, salted, or otherwise prepared; the exemption from all taxation of those persons who operate private salmon hatcheries and liberate fry at the rate of 1,000 for every 10 cases of salmon canned; the prohibition of any trap, barricade, dam, or other fixed obstruction in any waters at any point where the distance from shore to shore is less than 500 feet wide, or within 500 yards of any salmon stream less than 500 feet wide at its mouth; the prohibition of any kind of net fishing which obstructs more than one-third the width of any stream, creek, estuary or lagoon; the prohibition of the laying of any seine or other net within 100 yards of any other net, and of the setting of any trap or other fixed appliance within 600 yards laterally or 100 yards endwise

of any other similar apparatus; the prescribing of a weekly close season for allkinds of net fishing; the authorizing of the Secretary of Commerce and Labor to restrict or altogether prohibit fishing in waters where there is evidence of over fishing, and to set aside any waters as preserves which he may deem desirable; and the prohibition of the canning or salting of salmon dead more than forty-eight hours; and the misbranding of any canned, salted, or otherwise preserved fish. From the foregoing it will be seen that a very comprehensive and satisfactory law has been enacted, and much benefit to the fisheries should be the immediate result. The tax on preserved fish, amounting to about $100,000 annually, was in the bill, as passed by the House, devoted to fish cultural work in Alaska; but this feature was not approved by the Senate and was not insisted on by the House.

The ravages of dogfish on the Atlantic coast, and the apparent willingness or inability of the states to cope with the problem of combating these destructive fish, led to the flooding of Congress with petitions praying for government aid. The plans and hopes of the petitioners were expressed in a bill introduced by a Massachusetts member of the House which provided for a bounty on dogfish to be paid out of the treasury of the United States, the bounty being 2 cents for each dogfish tail delivered to the proper officials of the United States government. The bill applied to the section between Cape Hatteras, N. C., and Eastport, Me., and had for its sole object the extermination of the dogfish.

In a hearing before the House committee, the very serious damage being wrought by these sharks was fully set forth by the author of the bill, by representatives of the fishermen, and especially by the chairman of the Massachusetts fish commission who had made a very thorough investigation and report of the matter. A representative of the Bureau of Fisheries, while conceding all that had been claimed in regard to the destructiveness of the dogfish, expressed doubt as to the efficacy of the proposed bill in materially reducing their abundance, and called attention to the far-reaching precedent that would be established if Congress should begin to pay bounties for noxious animals. The contention of the Bureau was for government assistance, but this should be in the direction of "determining the most effective methods of reducing the numbers of dogfish and of capturing

them in wholesale quantities; in demonstrating the economic value of dogfish as a source of fertilizer, oil, and leather, and the the most suitable methods of utilizing them for such purposes; and in testing the usefulness of the dogfish as food when used fresh or prepared by salting, smoking, and canning, and in developing the domestic and foreign markets for such preparations." The views of the Bureau were embodied in a bill, but Congress adjourned without taking any further action.

The most important measure recommended by committee which failed of passage was the so-called "omnibus fish hatchery bill." For a number of years no new fish-cultural stations had been authorized, except those provided for Alaska by the fifty-eighth Congress; and a large number of hatchery bills had accumulated in both Senate and House, and some of these had from time to time passed the Senate. In March, 1906, the House committee on the merchant marine and fisheries made a favorable report on a bill directing the establishment of twenty-three new hatcheries in as many states, and one combination biological station and hatchery on the coast of Florida. The bill carried an appropriation of $637,000, and would undoubtedly have passed by a large majority if it could have been taken from the calendar. It is generally believed that at the next session the measure will become a law.

FISH DISTRIBUTED BY PENNSYLVANIA FROM JANUARY 1, 1906, TO JULY 1, 1906.

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

Miscellaneous fish	1,296	
Black bass	6,000	
Frogs	144,000	
Muscallonge	155,000	
Rainbow trout fingerlings	169,750	
Shad	1,013,000	
Smelts	5,000,000	
Lake trout fry	6,630,000	
Brook trout fingerlings	10,388,500	
Whitefish fry	36,764,000	
Lake herring fry	39,120,000	
Pike perch fry	50,600,000	
Yellow perch fry	63,505,000	
Pickerel fry	179,150,000	
Total distribution		394,646,546
In hatcheries yet to be distributed:		
Black bass approximately	160,000	
Frogs approximately	100,000	
*Sunfish approximately	100,000	
Cat-fish	200,000	
Gold fish for schools	25,000	
Miscellaneous fish	100,000	
Grand total		395,331,546

*A large allotment of sunfish is at the Pennsylvania Department of Health to be used in the attempted extermination of malaria-breeding mosquitoes.

PROGRESS AND EXPERIMENTS IN FISH CULTURE IN THE BUREAU OF FISHERIES DURING THE FISCAL YEAR 1906.

BY JOHN W. TITCOMB.

Experiments in the use of a salt solution for picking eggs by the *O'Malley process were continued at the Baker Lake and Baird stations and at the Bureau's laboratory in Washington, with the following results:

Superintendent O'Malley of the Baker Lake station reports that the solution was not used in the blueback salmon work, as the loss on this species was too small to warrant it. It was quite generally used in picking eggs of the silver salmon at both Baker Lake and the Birdsview substation, and for removing dead eggs of the steelhead trout at Birdsview the solution was depended upon entirely. It was found that the solution was in the best working condition when the specific gravity scale registered 1.076 With this solution nearly all the bad eggs floated long enough to be removed and all, or nearly all, of the balance could be picked by returning them to fresh water and putting them through the solution on the following day. As a rule the second application was not necessary because only a few bad eggs remained and these were picked out by hand in a few minutes. At the Birdsview substation the loss on the eggs ran as high as ten per cent. and the use of the solution resulted in a great saving of labor.

At the Baird station the use of the solution in picking eggs of the chinook salmon did not prove satisfactory but at the Battle Creek substation, where there was an unusual loss of eggs due to muddy water, the solution was used with most satisfactory results. The account of Superintendent Lambson's experiments is given as follows:

"Unfortunately orders to experiment with the solution were not received until the eggs at Baird had been eyed and picked ready for shipment. In the experiment of December 29 a small

*Salt Solution as an Aid to Fish Culture, by Henry O'Malley. Transactions of the American Fisheries for 1905.

hydrometer was used for testing the specific gravity of the solution; in that of February 2, a specific gravity scale furnished by the Department was used.

"Experiment No. 1. A solution of 1 part salt to 9 parts water was placed in a tub, the hydrometer reading 44; 20,000 salmon eggs, good and bad, were placed in the solution, and at the end of two minutes about 66 per cent of the bad eggs floated at the top and were removed with a scaff net, 34 per cent sinking to the bottom with the good eggs. A few good eggs floated at the top with the bad eggs. After remaining in the solution the eggs were removed to running water. They were then well washed and again placed in a solution reading 42 on the hydrometer and all of them, good and bad, promptly settled to the bottom. They were then returned to the trough. The eggs used in this experiment were from a lot that had been injured during the tender stage by an operator lifting the basket by mistake when packing for shipment. They were not picked at that time and when the salt solution was used the good eggs in the lot were well eyed while the dead eggs were just at the closing of the blastopore. The good eggs were not in the least injured by the salt solution.

Experiment No. 2. In this experiment the specific gravity scale was used and the eggs were all picked and counted before placing them in the solution. In a salt solution reading 1.076 on the S. G. scale 700 good eggs and 100 bad eggs were placed. Within three minutes 95 per cent. of the good and 5 per cent. of the bad eggs settled to the bottom. The bad eggs floating at the top were removed with the scaff net. The eggs were then returned to fresh water and well washed. After remaining in the fresh water for 30 minutes to remove all trace of the salt they were replaced in the solution, which had become diluted by the fresh water from the eggs and now registered 1.070 on the scale. In one minute all the good eggs and four of the bad ones settled to the bottom, while 96 bad eggs floated at the top and were removed by the net. The good eggs were all well eyed but the bad ones were unfertilized and had been held several weeks in pickle, though they were thoroughly freshened before being used. The good eggs were not injured by the salt solution and were packed

and shipped. The experiment could not be concluded owing to lack of eggs.

Experiment No. 3 was the best test of the solution since the experiments were started. It was carried on at Battle Creek Station where a large number of eggs had been killed by heavy storms carrying great quantities of mud into the hatchery during the very critical period. The acting foreman telephoned that it would be impossible to pick them by hand as in some cases the bad eggs greatly outnumbered the good, and extra pickers would have to be employed. It was impossible for the superintendent to go there at the time, and the acting foreman was directed to place the bad lots in a salt solution of 1 to 9 and if this did not work to strengthen or dilute the solution as required. The manner in which the experiment was conducted renders it worthless because the strength of the solutions is unknown but it is valuable in that it shows what may be done with large numbers of bad eggs. About 20 gallons of the solution, 1 of salt to 9 of water, was placed in a tub and 6,000 eggs in a basket were immersed in it. As soon as the eggs were placed in the solution they were at once agitated with the hand to break up any bunches among them. All the eggs floated and after remaining in the solution for three minutes they were returned to the basket. Fresh water was then added to the solution and the basket of 6,000 eggs was again placed in it. This time 75 per cent. of the bad eggs floated and were skimmed off, a few good eggs also floated but not enough to count. The good eggs went to the bottom in one minute. A little salt was added from time to time to keep up the strength of the solution as it became diluted by fresh water carried from the troughs by the eggs in the basket. Eggs were thus treated to the number of 2,267,500. As there were about 45,000 eggs to each basket it was necessary to divide them into seven or eight lots as good results could not be obtained with a larger number. In making the transfer from the trough basket to the dipping basket they were handled the same as in packing for shipment, that is, they were dipped from one and placed in the other with the regular hatchery dipper. After the eggs were removed from the salt solution they were emptied into another basket placed in the trough with running water, where the 25 per cent. bad eggs that failed to come to the top

were removed by the regular egg pickers. At no time could over 75 per cent. of the bad eggs be made to float. An examination of the bad eggs that persisted in sinking showed that they were eyed and had been killed by an influx of mud from a second storm occurring several days after the storm that killed the great majority. As the 25 per cent. were almost as old as the good eggs it would appear to prove that eggs killed at this time are of the same specific gravity as good eggs at the same stage of development, and therefore will not float in a solution in which good eggs sink. The acting foreman could not determine the exact strength of the salt solution as he had neither scales nor hydrometer. He estimated the amount in the first instance and then tempered it by adding water or salt until the best results were obtained. The eggs were not injured in the least by the brine and were later packed and shipped. This test comprised such a large number of eggs that it is considered conclusive. It seems to demonstrate that it is perfectly practicable to separate bad eggs from good ones provided the good eggs have reached the stage where they may be handled with safety and have developed beyond the stage of the dead eggs when killed. In other words there must be a difference in the development between the good and dead eggs to make a difference in the specific gravity, so that the heavier or good eggs may sink while the lighter or dead eggs float.

From the experiments made with this solution, conducted during portions of two seasons, the conclusion has been reached that for removing dead eggs normally occurring in the hatchery the process is not practicable at this station for the following reasons: It cannot be used until after the eggs have passed the tender stage, a period ranging from 12 to 20 days according to temperature. If they are not picked during this time the bad eggs will gather fungus and kill many good ones. The eggs collect in lumps and the salt solution has no effect upon them until they have been separated. As from 40,000 to 50,000 eggs are placed to a basket it would be necessary to handle them seven or eight times to get results, and as they are frequently shipped before they are eyed there is great danger of loss in so much handling. Then it is found that eggs of equal development will not separate in the solution and only such eggs that have died

some time before can be removed in this way. The eggs are picked during the tender stage as it is believed much stronger fish and smaller losses result than where they are covered until after they pass the tender stage, and if the salt solution were depended upon this could not be done. Even when the eggs are covered during the tender period it is customary to give them a very thorough picking during the first three days they are in the hatchery and where this is done there is no benefit to be gained from the salt as the death rate is very small; if the eggs are covered without this picking they must remain in the basket with all the dead and unfertile eggs for twelve to twenty days, which would certainly cause a very heavy loss. The solution is considered very valuable in removing dead eggs in special cases, such as noted in experiment No. 3 at Battle Creek. Here the eggs were all killed in a given period, and were in such numbers that it would not pay to pick them by hand. By the salt solution they were removed and the remaining good eggs saved. Accidents will happen at hatcheries, killing eggs in large numbers, and in such cases by waiting until the good eggs have grown old enough to handle, they may be readily separated from the bad ones with the salt solution.

To further test in ascertaining the value of this discovery laboratory tests were made by Mr. M. C. Marsh, scientific assistant, with eggs of four species of salmonoids. His results are reported as follows:

LAKE TROUT FROGS.

"Living eyed eggs float in a solution whose specific gravity is 1.076, and sink immediately in 1.058. The correct solution lies between 1.067 and 1.070. The latter is nearly always too strong. 1.068 effected an excellent separation with eggs killed by hydrochloric acid the previous day. Such eggs are uniform, all have the same specific gravity, and all float for one minute or more in the above solution. Eggs which have died naturally on different days and lain in the troughs for different periods are not so uniform, and the separation is not so complete. Some will sink immediately in the above solution. With those tried 50 per cent. to 75 per cent. were separated. Eggs killed at one time by smothering are also uniform and may be separated almost completely.

EYED WHITEFISH EGGS.

"Whitefish eggs nearly ready to hatch have a much lower specific gravity than lake trout or brook trout eggs. At 1.034 nearly all float, while at 1.029 they sink immediately. The best separation occurs at about 1.029. Eggs smothered or acid killed on the previous day may be almost completely separated by the above solution, although such eggs do not turn completely white within 24 hours after death. Like the lake trout, miscellaneous dead eggs dying naturally but not the same day, in the jars, do not separate completely, but yet a large percentage may be removed.

RAINBOW TROUT EGGS.

"Living eyed rainbow trout eggs from Wytheville, Virginia, nearly ready to hatch float at 1.079 and sink immediately at 1.060. At 1.066 considerable separation occurs, but the most favorable strength is about 1.072. Acid killed eggs may be thoroughly separated, though not perfectly, by this strength.

"The eggs for these trials were killed by pouring a little dilute hydrochloric acid upon some eggs in water in a beaker. Great activity was immediately shown by the embryos, which soon ceased (within ½ minute), leaving the embryos faintly whitish so that the eggs were distinguishable immediately from good eggs. After washing away the acid and returning the eggs to the tray on the water flow, the embryo after about one hour became more conspicuously white, and the next day the whole egg had turned white.

"Some unfertilized rainbow trout eggs from Manchester, Iowa, accompanying a shipment of eyed rainbow eggs, were tried in various salt solutions with a view both of separating them from other eggs and of determining the effect of the salt solution after returning the eggs from it to water.

"No separation of the unfertilized eggs from living eyed eggs could be made, as they were found to float or sink at practically the same time. They can, however, be separated from dead eggs turned white in the same way that the fertilized eggs are separated.

"The unfertilized eggs failed to turn white after treatment with the salt solution and return to fresh water. Following Mr.

O'Malley's procedure, a 1 to 20 solution was made, which had a specific gravity of 1.039. The unfertilized eggs were immersed in this, allowed to remain for a half-minute, and then returned to fresh water. Even after remaining in water over night they had not turned white, and were not distinguishable from untreated eggs. Stronger salt solutions were tried, but even after 1.125 for 25 minutes they did not subsequently change their appearance.

"The most effective separation of white eggs from live eggs and from unfertilized eggs which had not turned white was in a solution of specific gravity 1.077, and not in 1.072 as with former lots.

BROOK TROUT EGGS.

"Living eyed eggs nearly ready to hatch float in 1.077 and sink in 1.072. Specific gravity 1.0725 separates acid killed eggs almost perfectly, nearly every dead egg rising and nearly every live egg sinking within the first minute. There was no opportunity to try eggs which had died in the trays.

REMARKS.

"These trials refer only to eyed eggs and unfertilized eggs of the same age. Green eggs have not been tried, but since it is claimed that salt solution has much separating power with unfertilized eggs (salmon) at an early stage of development" and with "very immature eggs", it may be conjectured that the same will hold true of trout eggs.

"Eyed eggs which have died simultaneously may be well separated by this method. Eggs which have died successively vary in specific gravity and can be separated less completely, but nevertheless considerably. Its application practically will depend mainly on the condition of the dead eggs in this respect, but is indicated as possible with each species named and probable with the brook, rainbow, and lake trouts.

"The salt solution should always be adjusted with a hydrometer (salinometer). Special salinometers may be made to order to some advantage, but the ordinary hydrometers on the market will answer. Salinometers made for sea water are inapplicable for any of these species save the white fish, since they

do not usually read above 1.030. The highest of the usual series of three may sometimes be used for whitefish. The trials were made by immersing the tray itself with the eggs upon it in the salt solution.

"Evidently the temperature of the salt solution need only be such as not to injure the eggs by the temperature change. The temperatures of the solution actually used was between 43° F. and 52° F., and the eggs were taken from tap water at about 42° F.

"In no case did any injury appear from the action of the salt solution.

"The densities given here as correct for a given species need not necessarily be rigidly adhered to. In practice at different stations a somewhat different density may be preferable on account of the variation in lots of eggs from different sources, and the specific gravity instruments or hydrometers used may not correspond exactly. In these trials the density was taken in a glass cylinder, and the hydrometer was read by reviewing the scale from below the surface and not by the water which creeps up the stem above the surface. If in practice it is more convenient to float the instrument directly in the tank or box of salt solution the observer can not take the reading in this way but may adopt any uniform method, remembering that this will introduce another slight variation from the densities given above.

"Lake, brook, or rainbow eggs, recently dead, in which the embryo but not the egg has turned white, do not separate well from the live eggs.

"From a lot of eyed lake trout eggs arriving at Central station January 16, and containing a number of dead eggs, about 70 per cent. of the dead eggs were separated January 16 by a 1.068 solution. A few live eggs were contained among the dead removed from the surface of the solution."

It will be observed that no laboratory tests were made to distinguish dead or unfertilized eggs at early stages of development. If this feature of Mr. O'Malley's discovery is practical with eggs of other species than those already tested—notably those of the brook trout and lake trout—it will facilitate the preparation of eggs for long distance transportation, or for shipments to for-

eign countries where it is especially desirable to ship living eggs only.

It may be of interest to note that eggs which have turned white after death will assume the normal color of living eggs if allowed to remain in the salt solution for two or three hours. They resume the white appearance gradually when again placed in water.

NOTES ON POND CULTURE.

It is impossible in this article to go into detail as to the many experiments which have been made during the past year at the various stations, but definite data is being gathered as to the number of brood fish which can best be handled in a pond of given area and depth.

Some interesting observations have been made by Superintendent Green of the Fish Lakes station in connection with the spawning habits of the yellow perch, which entered one of the large ponds from the river as fry last season. When the ponds were drawn off the fish were placed in a smaller pond and retained through the winter. On April 2, when the water temperature was 50 degrees it was noted that they were spawning. They invariably cast their eggs on the west side of the pond. Several pairs were transferred to another pond where the same peculiarity was repeated. In order to further test the matter the following series of experiments were tried. On April 6, 12 pairs of perch were placed in a tank in which tufts of grasses had previously been placed at each end. On April 7, 8, and 10 clusters of spawn were found at the west end only. On April 10 several pairs were placed in another tank and tufts of grass deposited at the east end only. In this experiment one cluster of spawn was discovered on April 11 on the west side. The conditions were not changed, however, for five days, during which time no eggs were cast. The grass was then transferred to the west end and the following morning, April 17, three clusters of eggs were found on the west side. Another interesting observation was that the eggs were invariably cast at about five o'clock in the morning. The night watchmen were instructed to make observations every hour from four p. m. to eight a. m., and during the intervening time the observations were continued by other as-

sistants during the entire spawning season. The investigations were assisted by bright moonlight nights so that the movements of the fish could be noted accurately. They invariably appeared along the west side of the pond about five o'clock in the morning just at break of day. The eggs being cast at daybreak, it is inferred that the fish selected the sides of the ponds and tanks which first received the sunlight. It is interesting to note that the fish were but one year old when reproduction commenced. Actual measurement of some of the smaller specimens showed the males to be 4½ inches in length and the females from 4¾ to 5 inches in length.

While collecting small-mouthed black bass fry from the spawning beds in a natural lake in Pennsylvania some nests were found containing eggs, very young fry, and fry ready to scatter. As the fish culturist in charge did not visit this lake until after many of the fish had finished spawning, no observations were made as to just how this happened. It would be interesting to learn whether more than one brood of fish worked on the same nest or whether one male invited several females to spawn at different periods on the same nest. The adult fish in this lake are very small and the average number of fry collected per nest was only about 250, the maximum number from one nest being 470. The lake where these operations were conducted is one of a group on the preserve of the Blooming Grove Hunting and Fishing Club in the town of Gleneyre, Pennsylvania. It is overstocked with small-mouthed black bass and evidently owing to lack of food the fish have become stunted. On June 5, several hundred nests containing eggs were examined on the south and west shores of the lake. Several days later these eggs had all disappeared. No fish hatched on these nests and there was no evidence showing that the eggs had died. The eggs were apparently devoured by the numerous bass. On nests where the eggs hatched or died a green moss soon appeared over the decaying eggs or shells but no such moss appeared over the several hundred nests on the south and west shores. Great difficulty was experienced in keeping the young fish alive more than twenty-four hours. They were taken from the nests soon after they began to rise from the beds. Unfortunately the bottom of the lake in the shallows is too rocky to permit of seining young

fish. It was found that when the young fish were left to roam about the shores for several days or weeks they were in much better condition for transportation.

EFFECTS OF LIGHT ON EGGS AND SAC FRY.

At the White Sulphur Springs station the water at times apparently contains noxious gases and at other times is superaerated. As a result the so-called "white speck" disease has occurred annually. In connection with the experiments in deaeration by the use of perforated pans observations in a general way showed that in some troughs of eggs and fish of the same lots there occurred losses of such marked variation as to attract especial attention. The fish culturist noticed that in the troughs of eyed eggs as well as young fish subject to a great amount of light the heaviest losses occurred. Control tests with eggs exposed to the sunlight after being eyed and eggs kept in a covered trough did not show much variation in mortality, the very slight difference being in favor of the covered trough. However, soon after the fish hatched there appeared a marked difference in the losses, the fish in the sun-exposed trough dying much faster than those in the covered one. The loss continued for some time but again became about normal or equal in daily loss to the covered trough. When the yolk sac was about absorbed and the fish were nearly ready to feed the cover on the darkened trough was removed, and in a few days thereafter the fish in this trough began dying rapidly, while the loss in the exposed trough remained about normal. All the fish that died developed the "white speck" disease. The fry in the troughs were carried to the fingerling stage and the percentage of loss in the covered trough amounted to 47.2 as against a loss of 64.8 for the unprotected trough, making a difference of 17.5 per cent. in favor of the darkened trough. Superintendent Robinson suggests that had the cover not been removed for a longer period the percentage of loss would doubtless have been only normal, as the fish in the darkened trough failed to develop the "white speck" disease until after being exposed to the sun, which indicates that sunlight as well as very strong light has a deleterious effect upon not only green and eyed eggs, but upon fish previous to the total absorption of the

sac. Further control experiments will be made in order to obtain more definite information on this subject.

SUPERAERATED WATER.

A suggestion comes from Fish Culturist G. W. N. Brown of the Erwin station that fry being carried in troughs supplied with superaerated water will thrive best if less than the normal supply flows through the trough. No control experiments have been made, but it is suggested that when opportunity is offered it would be a good idea to make control experiments along this line. He speaks of carrying from 30,000 to 50,000 trout fry from the period of hatching to four months old in troughs having a flow of water from three to seven gallons per minute. It was observed that when the flow of water was increased the death rate increased correspondingly.

COPPER SULPHATE AS APPLIED AT A TROUT HATCHERY.

At the White Sulphur Springs, West Virginia, station the water supply is from springs. For a distance of 200 feet from the intake the water is conducted underground in terra cotta pipes. It is then conveyed in an open-ditch for about a 1,000 feet. This ditch at the water surface is about seven feet wide, and from 2 to 3 feet deep. It is tapped at a number of places for supplying the different ponds. Spirogyro grown very rapidly in this open ditch, clogs the screens at the various intakes, and is thus very objectionable. It has been found that the application of copper sulphate in a mixture of about 1 part to 4,000,000 applied about 8 hours each week, almost entirely eliminates the algae, with no injurious effects upon the fish. After the copper sulphate has been applied for the stated period the fish eat but little food, and if applied 16 hours will entirely refuse it. The lack of appetite lasts but about 12 hours after the application has been discontinued.

The flow of water through the ditch was only roughly measured, hence the proportions given above may not be correct. The experiment was conducted under the direction of the pathologist of the Bureau, M. C. Marsh. The copper solution was dissolved in a barrel, and was applied at the head of the ditch by

the use of a siphon. In order to have the same volume of the mixture flowing constantly a floating siphon was used, so that the same head was maintained while the mixture was being siphoned off. The first test made was with an application of 1 part to 3,000,000. A few trout in the ditch were killed by this solution, and some of those in the ponds supplied with water from the ditch gave signs of uneasiness. With a mixture of 1 part to 4,000,000 there has been no loss of fish. This does not prove that the solution can be constantly applied in flowing water in the proportions above given, and what proves to be a proper remedy in this particular instance might be fatal to fish if applied in some other water system under apparently similar conditions.

In considering the eradication of algae in water supplies to trout hatcheries and ponds, and especially in connection with intensive pond culture, it must be kept in mind that Nature's balance as to water aeration may be upset if the algae is removed.

*An instance is reported at Cold Spring Harbor, New York, where a spring at the edge of a reservoir pond shows a deficit in oxygen of 1.25, while in the middle of the pond there is an excess of 3.11 in oxygen due to the thick growth of algae, chiefly Spirogyra, which lines the bottom of the pond throughout its entire extent, but is heaviest at the middle.

GROWTH OF EGGS DURING THE PERIOD OF INCUBATION.

Observations made at various stations indicate that fish eggs of almost all species propagated increase in size from the time they are water-hardened up to the time they are about to hatch. The amount of increase is not large but will run from about one to three per cent., according to the species. This suggests that it is unsafe to use the same measure for green eggs and those fully developed, especially when large lots are being handled. In this connection attention is called to a new form of measuring gauge to ascertain the correct diameter of fish eggs, devised by H. von Bayer, architect and engineer of the Bureau of Fisheries, a sample of which is presented for your inspection at this time. A scale of this character is very useful in making tests as

*M. C. Marsh: Tenth Annual Report of the New York Forest, Fish and Game Commission.

to the increase in the size of eggs during the period of incubation. In connection therewith Mr. von Bayer has prepared a diagram based upon which, after knowing the diameter of the egg, one can ascertain the number of eggs to the quart. This is especially useful in establishing the number of eggs to a quart where the actual number has not been ascertained by counting, as frequently happens in taking up the propagation of a new species. It is thought it will be especially useful in the propagation of fish the eggs of which have a small diameter.

SUMMARY OF DISTRIBUTION OF FISH AND EGGS DURING THE FISCAL YEAR 1906. BY THE BUREAU OF FISHERIES.

Species	Eggs	Fry	Fingerlings, Yearlings and Adults	Total
Catfish	.....	500	63,915	64,415
Shad	495,000	37,504,300	.....	37,999,300
Whitefish	73,099,000	263,400,800	.....	336,499,800
Bluefin whitefish	.....	1,140,000	.....	1,140,000
Lake herring	38,300,000	3,410,000	.....	41,710,000
Chinook salmon	115,628,645	21,789,928	122,980	137,541,553
Silver salmon	239,180	6,445,574	23,140	6,707,894
Blueback salmon	122,500	9,923,680	9,500	10,055,680
Humpback salmon	2,000	1,528,504	.....	1,530,504
Steelhead trout	113,000	2,038,879	178,056	2,329,935
Rainbow trout	401,400	366,415	1,427,535	2,195,350
Atlantic salmon	.....	1,897,607	78,717	1,977,324
Landlocked salmon	204,000	481,144	75,677	760,821
Blackspotted trout	810,000	6,988,918	1,100,356	8,899,254
Scotch sea trout	.....	.....	504	504
Loch Leven trout	.....	22,525	78,000	100,525
Lake trout	25,060,000	29,084,540	73,180	54,247,720
Brook trout	960,000	5,333,049	3,689,689	9,982,738
Golden trout	.....	218,000	.....	218,000
Grayling	592,000	415,000	.....	1,007,000
Pike	.....	.....	15,000	15,000
Crappie and strawberry bass	.....	.....	87,528	87,528
Warmouth bass	.....	.....	2,375	2,375
Rock bass	.....	.....	41,042	41,042
Small-mouth black bass	.....	155,150	39,499	194,649
Large-mouth black bass	.....	103,800	434,162	537,962
Bream or sunfish	.....	.....	93,085	93,085
Pike perch	136,100,000	232,055,000	.....	368,155,000
Yellow perch	.....	161,943,000	3,065	161,946,065
Striped bass	.....	2,351,000	.....	2,351,000
White perch	5,400,000	176,690,000	.....	182,090,000
Cod	.....	159,492,000	.....	159,492,000
Flatfish	.....	285,049,000	.....	285,049,000
Lobster	.....	117,787,000	.....	117,787,000
Total	397,556,725	1,527,615,313	7,634,985	1,932,807,023


180000 190000 200000
180000 190000 200000

EXPLANATION AND USE OF DIAGRAM.

"The diagram is constructed from a table computed by the well known principle that the contents of solids are to each other as the cubes of their sides, or in case of spheres as the cubes of their diameters. The diameter of the whitefish eggs was accurately determined by placing a row of eggs in a graduated trough-like measure 6 inches long, then counting the number of eggs and determining their mean diameter in decimals of an inch. A quart measure was then filled with eggs of this given diameter, accurately counted, and the result used as the base in the computation of said table.

FORMULA.

$$d^3 : d_1^3 :: n_1 : n$$

$$\therefore n_1 = \frac{n \times d^3}{d_1^3}$$

$d = 0.127''$	Diameter of whitefish egg.
$n = 33036$	Actual number of whitefish eggs per quart.
$d_1 =$	Any other determined diameter.
$n_1 =$	Number of eggs sought.

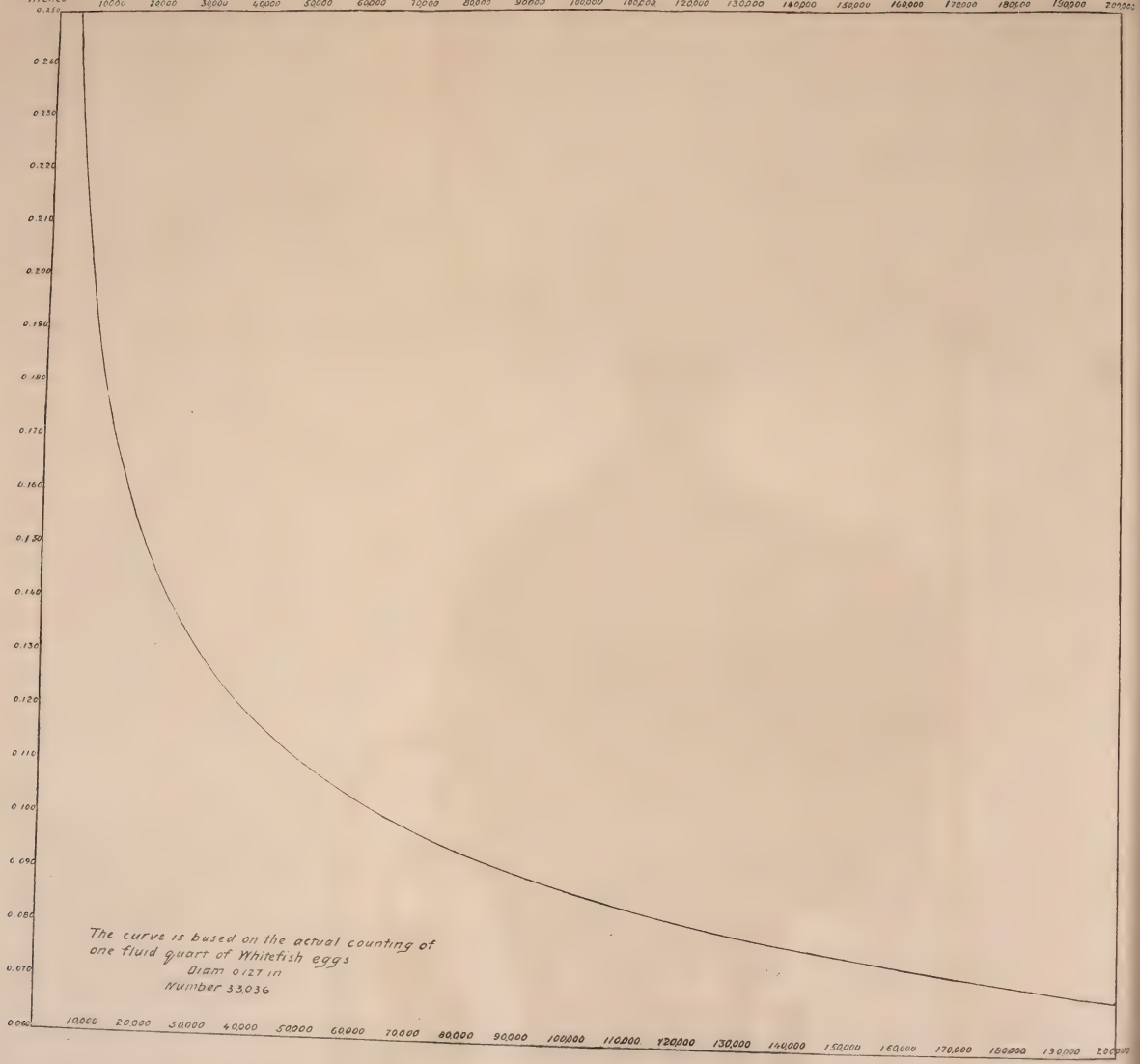
"To use the diagram for finding the number of eggs per quart, look for the line on the left margin corresponding to the given diameter and follow said line to the right until it intersects the curve; from this intersection proceed at right angles to the marginal line of figures and there read the required number of eggs per quart."

DISCUSSION.

Mr. Titcomb. (Introductory to paper.): The experiments reported last year have been continued. Many of them must be continued a series of years in order to get any definite data.

(At the close of the paper Mr. Titcomb said): Some observations were made this year as to the growth of eggs from the time they are water hardened until they are eyed. We tried almost every species which we propagate, and after trying several different kinds of scales for getting the actual diameters of the eggs, with the view of recording the growth, etc., the architect

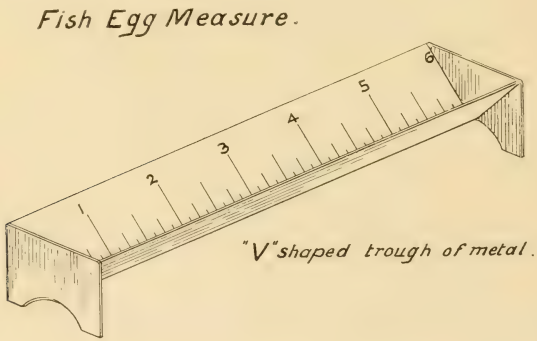
Diagram showing number of Eggs per fluid quart



of the Bureau devised this little scale or measuring trough. (Exhibiting scale.) It is just six inches long. You lay in just one line of eggs, and when it is just full you can easily get the diameter of each egg actually or the number of them to the inch. You can study the growth of trout eggs with it also. We tried ten selected lots and tried them when a day or two old, and again when eyed and we found a less number contained in the trough at the eye stage than when they were first water-hardened. It is interesting in several ways. Of course where you are measuring eggs in hundred million lots, like the whitefish and pike-perch eggs, if there is an increase in the size and you use the same measure in measuring eyed eggs, you are not measuring them accurately.

This really came up in connection with our trying to establish standard measures. I find there is a chance for improving our measure on some of the smaller eggs. When you get quarts of these fine eggs you can make a great deal of difference in total output by a very slight variation, and no two fish culturists will measure a quart of eggs alike. It is almost impossible for the same fish culturist to measure two quarts accurately. Now this diagram is not complete, because we could not get the whole scale onto this sheet.

But it is made on the basis of the actual count of whitefish eggs. We know the actual diameters of the eggs, which were counted by measuring several eggs in this little trough.



Then we counted 33,036 eggs to the quart, with the diameter of the eggs .127. Now in order to get the number to the quart you come down to 127 on the scale and run down till you strike this curve, and here should be the actual number to the quart. Supposing you are propagating some new species like the rock fish and in a new field; it is a long and tedious task when busy with your work to find out what the aggregate number of eggs is to the quart. But you take the little trough and get your diameter and find that the diameter is .150 say. You run out here on the 150 line of the curve and it reads 20,000. This appears to me as very interesting and very original.

President: You have heard this most interesting summary of experiments of the bureau of fisheries. Do they suggest any remarks?

Mr. Meehan: The reference, by Mr. Titcomb, to the lake in Pennsylvania is interesting. The conditions in that lake are so extraordinary that a little more detail might be interesting. That lake is in Pike county, Pennsylvania and was formerly known as Knob pond, now Lake Laura. The lake was stocked with black bass in 1870, when about 40 fish were placed there. In 1873 that lake was literally alive with black bass of a large size. The lake is a genuine kettle hole lake, that is, a spring lake, on the side of a moraine. The greater part of its area is shallow, but there are depths ranging from 40 to 50 feet. It covers an area of about 400 acres. The bottom is covered with boulders left there by the ice. In 1873 the lake was literally alive with bait fish; there were yellow perch and roach or shiners and crayfish. Today there is not a living creature in that lake excepting the black bass, except there may be an odd sunfish or two, something of that sort. The fish are very small. To give you an idea how small they really are, four years ago five gentlemen undertook to fish and they put up a jackpot on the largest fish that was caught. The five men went out and caught 250 bass, and a nine inch bass took the jackpot. That will show more clearly than anything else how small these fish really are. I doubt if the average length exceeds 6 or 6½ inches. Bass six years old and four or five inches in length are rather curious. The lake is simply alive with them. I was there when

the Bureau of Fisheries men were there last spring, and can corroborate everything that has been stated. As to the number of nests there were far more than 200. The number of eggs on each nest was very small and I saw also at that time the three types, that is, the eggs, the fish that were newly hatched, and the fish rising all on the same nest.

I also saw three types in another lake on the same property, Lake Giles. There on one occasion I found eggs and fry, and in that particular case I saw two females on a nest, but I did not see the third female. It was believed at that time that the male had had all three females.

The difference between Lake Giles and the other lakes is that all the nests in Lake Giles were in water from 6 to 8 feet deep, making it extremely difficult to get the fish out. Lake Laura is the most remarkable instance of over-protection with which I am acquainted in Pennsylvania or anywhere else. The club is a very close corporation and allows no public fishing there. The lake is about seven or nine miles from the club house and over one of the roughest roads that a human being ever traveled. It is much easier to walk it than to ride, and the consequence is that comparatively few people go there, and not more than 6,000 or 8,000 fish are taken out of that lake in a year. The consequence is that the fish have multiplied far beyond the number that there should be in that lake and that is undoubtedly the cause of the stunted growth of the fish. The bass, you know, have an inordinate appetite and they have destroyed every living thing in that lake.

Mr. Clark: I would like to ask Mr. Titcomb a question in regard to this chart. Taking the basis of .0127, as the diameter in the case of whitefish, it shows 33,000 to the quart. Now on that same basis would it work out on other fish?

Mr. Titcomb: Yes, if you have the right diameter and get the proper number to the quart.

Mr. Clark: I do not think it would work out with pike-perch. As we measure them now, there are 150,000 pike-perch to the quart, but the number would be considerably lessened according to the new plan advocated. The eggs ought to go

about twenty-two to the inch in your little trough here and it does not seem to me that it works out quite correctly.

Mr. Titcomb: In the first place, I think Mr. Clark's measure is too liberal and in the second place, when he says 22 to the inch and you are considering millions of eggs by this chart you must get your diameter down very fine; the diameters given in our manual, when you come to figure them for this purpose, are entirely too inaccurate. The manual says 1-7 or 1-16 of an inch, etc., and the table ought to be revised. You will find when you get your base right and get an accurate diameter of any particular species and the actual number of eggs to the quart of that particular species, from it you can make your curve. I would not say that this curve is safe for a future basis now, but it will be made so. We are trying to get other counts and diameters as accurately as we did that, before we make this a conclusive thing; but the mathematics of it is correct and I think you will find it is going to work out and be useful.

Mr. Clark: That is what I am trying to get at. It is not conclusive yet. What I based the twenty-two to the inch on, the way I measured them, is an inch between knife blades.

Mr. Titcomb: Take the measure accurately by machinery and you get it a little more closely.

Dr. Bean: This subject is one of very great practical interest, and I trust that the mathematics of the curve by which the number of eggs is worked out will be, and I suppose has been, based upon a large number of counts of individual eggs, because every one knows that eggs of any species have an individual as well as a geographic variation. For example, Mr. Clark finds 150,000 pike-perch eggs to the quart; at Constantia they have 130,000. This is perhaps due to the fact that the spawning fish from Oneida Lake run rather smaller on the average than the spawning fish from which the United States Bureau obtains its eggs. But I wish to emphasize the necessity of containing the counts of eggs so as to eliminate individual and geographic variations; and then the scale, it seems to me, would be a great boon to our practical workers.

Mr. Titcomb: There is where the value of this scale comes in. When we once get the scale established we can take the pike-perch eggs at Dr. Bean's Lake and find they measure a certain diameter; take the eggs at Northville and find they measure another diameter; and we start a field station at Saginaw Bay and we find still another diameter. Now we can in a very few minutes, establish a diameter by taking a number of series of eggs from the various lots and thus determine the number of eggs to the quart in each instance and the very variation of the diameter of eggs of the same species is one of the features that makes this plan of measurement important. If we could say that pike-perch eggs run so many to the quart all over the country, we could get that established by counts from a dozen hatcheries and that would be the end of it; and here we go out to a new field and get the number of eggs to the quart from that chart in five minutes. You simply measure the number of eggs to the inch by means of the trough and the chart does the rest.

President: So that the use of this little chart scale is the essential thing after all.

Mr. Titcomb: It is very important.

Prof. Reighard: I was interested in what was said in regard to separating the dead eggs from the living; I would like to ask Mr. Titcomb whether the reason for the floating of the dead eggs in the salt solution has been made out? Is it due to the development of gas in the eggs through decay so that the dead ones float and the good ones sink?

Mr. Titcomb: I do not think it has been worked out to that extent. We assumed that the dead eggs immediately begin to decay and naturally the specific gravity becomes less than that of the live eggs.

Prof. Reighard: It occurs to me, that if that is the reason, possibly the method might be improved by waiting for that decay to proceed a little further. That is to say, if at a certain time you can separate 75 per cent of the dead eggs by means of a salt solution, by waiting a little longer time for the decay to take place, if it did not injure the living eggs, it would enable you to separate all dead eggs from living eggs.

Mr. Titcomb: We are able to do it in some cases now.

Prof. Reighard: If you wait till all the dead eggs have formed gases enough to float them, you might separate all of them at one time without having to pick over the eggs at all,—assuming, of course, that the formation of the gases in the dead eggs would not further injure the living eggs.

Mr. Titcomb: I do not know as I brought out one point developed in this experiment, that I intended to mention. You know you have many unfertilized eggs which retain the color of the live eggs for a long period, especially in cold weather, and if you want to pack the eggs when they are barely eyed, for a 40 or 50 day shipment, it is difficult to eliminate all those unfertilized eggs. If you put those unfertilized eggs in salt water and then back into fresh water, it causes them to turn white more quickly. That might be preferable to jarring the eggs, as they call it, giving them too much of an agitation to get the dead eggs out.

Mr. Lydell: I would like to ask Mr. Titcomb if the object of this chart is to establish bases for the measurement of eggs at different stations. All the eggs I received from the United States Fish Commission this year, which were measured, overran. Out of 100 quarts in one instance, I made the eggs measure 108 quarts, and I thought I was very careful in measuring them; but this chart, as I understand it, is to establish a basis for each station in different localities, inasmuch as the eggs are of different sizes in different localities, and not to establish a general law for measurements everywhere.

Mr. Titcomb: Yes sir.

President: Your statement as to the variation in measurement of the eggs you received, illustrates what Mr. Titcomb said, to the effect that no two men will measure the same eggs exactly alike, nor will the same man get the same results twice.

Mr. Lydell: I doubt whether the same man could measure 100 quarts of wall-eyed pike eggs twice alike.

Mr. Titcomb: My purpose in suggesting the use of the trough and chart scale is simply to have a standard for each sta-

tion, and not a general standard. I do not think it is safe to have a general standard, and the Bureau of Fisheries does not want any more eggs planted or distributed on paper than are actually put out; and that is so also of a good many states; I want to emphasize the fact that there are a good many states where they can make 300 or 400 per cent. of fingerling fish out of 100 per cent. of eggs, and we know that they have not had any eggs except those that have been sent to them; but this difficulty in measuring is another matter. We want to find a measure that will not vary. We have discussed different ways, we have discussed having a quart measure that tapers to a small diameter at the top, as the variation is, of course, very largely in the filling up at the top.

Mr. Nevin: The pike eggs we get at Lake Winnebago run 120,000 to the quart, while those we get at Tomahawk Lake run 80,000 to the quart.

Mr. F. R. Bassett: I would like to ask Mr. Titcomb regarding the separation of eggs by salt, if the floating eggs will remain floating during an indefinite time, or will they eventually sink?

Mr. Titcomb: I cannot answer that accurately. My impression is that they do not; that they sink.

Prof. Reighard: There is one other point in Mr. Titcomb's paper that interested me, viz: the finding of eggs and two different stages of fry in a single bass nest. It seems that this occurred in lakes where bass where very numerous, where there was overcrowding. Now, from what I know of the habits of bass and the other fish of that family, I take it that the male fish guarding the nest will continue to receive females, as long as there are females available, within certain time limits. It is simply a question of the number of females. As a practical point the condition referred to may perhaps be prevented by avoiding overcrowding. This might be a very serious matter, because very likely the old fish leaves the nest as soon as the first of the young are ready to leave and leaves the younger part of the brood to perish in the nest.

President: I would like to ask whether these old bass leaving the females indicates any human proclivities. (Laughter.)

Mr. Clark: We had an occurrence of that kind in a pond at Northville this year. The fry were nearly ready to rise when another female came and spawned on the same nest. Of course, it was necessary, in order to catch the fry that were rising, to put a screen over the nest, and the second lot of eggs died.

Mr. Titcomb: I want to ask Prof. Reighard if he thinks that the same male performed family duties for all three litters on one nest.

Prof. Reighard: I think that is very likely. I have known it to have taken place with the sunfish, and Mr. Lydell can tell you of one case where the same thing occurred with a bass.

Mr. Lydell: I have had several cases where the same male has taken care of two broods, and one where he has taken care of three broods, but not all at the same time. The fry after they arose were screened and taken away from him, then another female came on at once and we had a third lot of fry the same season. He was marked, everybody knew him and he would feed out of your hand. He had the whole pond to himself, and had an outlet to a big pond, and he actually reared three schools of fry in one season. The second was not as large as the first and the third was still smaller but in each instance we took the fry away from him. That applies to all males at Mill Creek. They receive the females as fast as they come. (Laughter.)

Mr. Titcomb: Last night Prof. Reighard spoke of the sunfish, when the second female appeared, cleaning off the nest which had the eggs on it. In the case of bass it is apparent that the male does not so readily oust the first family of young when he performs his duties with the second female. They clean off but once, I think.

Prof. Reighard: I do not know whether they ever clean the second time.

Mr. Bean: I wonder whether Mr. Titcomb or Mr. Meehan can give us any explanation of the unusual production of small mouth bass in these Pennsylvania lakes.

Mr. Meehan: It is only one lake.

Dr. Bean: Usually it is believed there is a good deal of cannibalism among these bass. Why don't the biggest bass eat the smaller ones, and thus reduce the number, as occurs in other places? If they have nothing else to feed upon, why do not they feed on one another?

Mr. Titcomb: They do feed on other food to some extent. There are shrimp there and other varieties of food under the rocks; there is quite a lot of insect life under small flat stones, but the race has become a stunted one, apparently for the lack of food.

I have knowledge of a lake in Vermont, formerly inhabited by several species of common fishes; the bullheads are one of them, and the yellow perch another. It was stocked with small-mouth bass which cleaned out every other kind of fish in this pond, and then became a stunted race, the maximum weight of the fish being about ¾ of a pound. Very likely it was so in Lake Laura. We used the fish in the Vermont lake to stock larger lakes for several years.

EXPERIMENTS IN FASTING OF FRY.

BY CHARLES G. ATKINS OF EAST ORLAND, ME.

It is my purpose in this paper to give further account of the experiments in the initial feeding of fry of which I told the Society last year.

The purpose of those experiments was to test the correctness of the opinion, generally held among fish culturists, that it is necessary to be very prompt in satisfying the first demands for food on the part of the fry of all kinds of salmon and trout, the penalty of neglect being the death or irreparable injury of the neglected fry, some writers on the subject having gone so far as to lay down the rule that there is no safety in the matter short of actual anticipation of such demands by offering food to fry a good deal before the absorption of the sack.

I was able to say at the time of the last meeting that, so far as could be seen up to the month of July, fry that had called for food in May or early in June and had been compelled to wait for five days had not appeared to suffer in consequence,—at least such treatment had not increased the death rate; that fasting for nine or ten days had not in all cases been followed by heavier losses; that in the case of the fry of silver salmon, of which four lots had fasted respectively for five, ten, fourteen and nineteen days, those that fasted the longest suffered the lightest mortality; and that the majority in the four lots of silver salmon taken together, from the beginning of the fasting down to fifteen days after its close with each lot, averaged little more than half as heavy as that of the kindred fry that were promptly and constantly fed.

In the discussion that followed the reading of that paper it was suggested by Mr. Talbot that though these fishes survived the ordeal of the fast they might have been so stunted by it that they would never reach the size that they would otherwise attain; and I was compelled to acknowledge that there was good ground for fearing that such would be the effect. I have now evidence in this matter which I am glad to lay before you.

All of the survivors of the starvation treatment in 1905 were kept through the season until October, each lot by itself, and fed and otherwise treated as nearly as possible in a uniform manner, except as to space, an exception that I shall refer to again. These experiments were tried in wooden troughs, all 12¾ inches wide, and with a water depth of 4 or 5 inches.

First let us look at the experience with Atlantic salmon. There were two series of experiments with this species, each series embracing four lots. The lots of the first series numbered at the start each 1,000 advanced fry, and each lot was maintained in a trough ten feet long. The lots of the second series numbered 500 each, of the same age and origin, and they were kept in troughs five feet long. In each series the fasts were for 5, 10, 15 and 20 days respectively. It was found, as stated in the former paper, that for a period beginning with the commencement of the fast and extending to 15 days after its close in each case, Atlantic salmon that had fasted for 5 days suffered a lighter mortality than those of the same origin that were fed promptly; that those fasting 10 days suffered a lighter mortality in one case and a heavier in the other; but that the fasts of 15 and 20 days were followed by a greatly increased mortality in both series. This indicated that 10 days was perhaps longer than such fry could be safely compelled to fast under the given circumstances.

For the purpose of comparing the death statistics of these fishes through the rest of the season I have arranged a statement in which the number of fish left at the beginning of each month is made the basis of the percentage for that month. On this basis it is found that the losses in both series of Atlantic salmon were much heavier in the cases of the most extended fasts; for August the losses were exceedingly light,—but a trifle heaviest among those that had fasted 15 and 20 days; for September the difference, though almost extinguished, still holds against the 20-day fasters of the second series, while in the first series the heaviest losses followed the 10-day fasts, next coming the 20-day and 5-day fasts successively, and the loss following the 15-day fast being the lightest of all. These September losses were, however, exceedingly small, the heaviest being less than one per cent.

On the 17th of October, all these Atlantic salmon were

weighed, and it was found that the heaviest fish were those that had the shortest fasts, they were averaging 35 and 37 grains respectively; but the smallest fish were not much smaller, 28 grains for the 15-day fast of the first series and 29 grains for the 20-day fasts of both series. Now comparing these with a control lot consisting of 2,986 fish that had been fed promptly and continuously, we find that the latter had not attained any greater size than the smallest of the first series of fasters and only a single grain larger than the smallest of the second series, and that out of the 8 lots of fasters there were 5 lots that actually outstripped in growth the full-fed fish.

Turning now to the brook trout, we find that in August and September the losses were very much heavier than with the Atlantic salmon, but the distribution of the losses was such as to forbid any decided conclusions favorable or unfavorable to the fasts. October 16th they were all weighed, with the very interesting result that the larger fish were among those that had fasted the longest, the average being, from the short fasts upward, 99 grains, 102 grains, 109 grains and 127 grains, successively, and the last named, which had fasted 19 days, had attained an average weight 14 grains (over 10 per cent.) greater than that of a lot of 3,595 trout that had not fasted at all.

The lake trout suffered so lightly during the late summer and autumn as to hardly afford any data except of a negative character (indicating that the fasting had done no harm) and in October the weighing showed that the two lots of greatest mean weight were those that had fasted the longest.

The mortality among the silver salmon was too light between June and October to afford data for comparisons, and the October weighing afforded data for only the negative conclusions that, when compared with each other, the long fasts had been little if any more detrimental than the brief ones; but when compared with a control lot of 2,441 salmon of the same species and age, it is found that these early and full-fed fish were decidely heavier than any of the fasters.

I must call your attention to certain points in which we are liable to err in our interpretation of the results above stated. Let us, in illustration, take up again the observations made on the brook trout. It was observed that the survivors of the brook

trout that fasted 19 days had attained, on October 16, a mean weight of 14 grains (or 10 per cent.) heavier than the fish of the same species and same original lot that had been fed promptly and abundantly, and that each move in the lengthening of the fast had been followed by an increase in size. Now without consideration of any other circumstances than those I have named, the conclusion is at once suggested that the fasting was the cause of the increased growth. But let us beware of jumping at conclusions. Let us see what other circumstances there were which may have had a bearing on the case. The different lots of trout in the experiment came originally from the same lot of eggs, so it is not likely that there could have been any congenital difference in capacity for growth. They were reared in water of the same origin and the same character in temperature and other respects. They received after the fast the same food, administered in the same way and, it was supposed, in the same quantity. But in one respect there was an important difference in the conditions to which the different lots were subjected: it was the matter of space. The lots of fasting trout were kept in troughs uniformly 5 feet long, while the main lots, the control lot among them, were in troughs 10 feet long. The survivors of the 19-day fasters, only 175 in number at the beginning of October, had about 5 square feet of space or 1 square foot for 35 fish. The other fasters had much less space, there being more fish to the square foot, and the control lot had, during the last part of the season, only one square foot of space for 107 fish, and earlier were still more crowded. Here, then, is an important advantage enjoyed by the subjects of the 19-day fast: they had three or four times as much room as the normally treated fish with which they were compared, and far more room than any of the trout that fasted for shorter periods; and this may account for their extraordinary gain in size.

There is one other point worth considering in this connection. It would seem almost inevitable that in the severe ordeal of the fasting experiments the fish that would soonest succumb would be the weaklings, and those that would survive the severest tests would be those of greatest innate powers of endurance and recuperation. This may have been another factor of importance in bringing about the remarkable results laid before you. And,

though it is going a little outside of the purpose of this paper, I venture to suggest that until investigation shall determine the matter, it be regarded as an open question, whether the starvation process may not be advantageously applied in a practical way to the weeding out of weak fish from our broods.

To sum up conclusions, I think the data here laid before you warrant us in concluding that fasting, carried to the extent of incipient starvation, though it may greatly retard the growth of fry and fingerlings in their early stages and produce actual emaciation, does not permanently stunt them but leaves with them the capacity of attaining normal size by rapid strides when placed under favorable conditions.

FASTING EXPERIMENTS 1905.

Lot No.	Kind	No. at Start	Length of Fast	Dates of Experiment
1832 A^1	Silver Salmon	500	5 days	May 18 to 22
1832 A^2	Silver Salmon	500	10 days	May 18 to 27
1832 A^3	Silver Salmon	500	14 days	May 18 to 31
1832 A^4	Silver Salmon	500	19 days	May 18 to June 5
1768 A	Brook Trout	1,000	5 days	May 23 to 27
1768 B	Brook Trout	1,000	9 days	May 23 to 31
1768 C	Brook Trout	1,000	14 days	May 23 to June 5
1768 D	Brook Trout	1,000	19 days	May 23 - June 10
1747 A	Lake Trout	100	5 ds. after 6 ds. feeding	May 23 to 27
1747 B	Lake Trout	100	9 ds. after 6 ds. feeding	May 23 to 31
1747 C	Lake Trout	100	14 ds. after 6 ds. feeding	May 23 to June 5
1747 D	Lake Trout	100	19 ds. after 6 ds. feeding	May 23 - June 10
1847 A	Atlantic Salmon	1,000	5 ds., unfiltered water	June 4 to 8
1847 B	Atlantic Salmon	1,000	10 ds., unfiltered water	June 4 to 13
1847 C	Atlantic Salmon	1,000	15 ds., unfiltered water	June 4 to 18
1847 D	Atlantic Salmon	1,000	20 ds., unfiltered water	June 4 to 23
1847 E	Atlantic Salmon	500	5 ds., filtered water	June 4 to 8
1847 F	Atlantic Salmon	500	10 ds., filtered water	June 4 to 13
1847 G	Atlantic Salmon	500	15 ds., filtered water	June 4 to 18
1847 H	Atlantic Salmon	500	20 ds., filtered water	June 4 to 23
1768	Brook Trout	19,174		
1832 C	Silver Salmon	2,500		
1847	Atlantic Salmon	.....		

FASTING EXPERIMENTS—Continued.

LOSSES AND PERCENTAGE BASED ON NUMBER OF FISH AT FIRST OF EACH MONTH.

Lot No.	May		June		July		August		September	
	Loss	Perc't.	Loss	Perc't.	Loss	Perc't.	Loss	Perc't.	Loss	Perc't.
1832 A[1]	6	1.2	3	.61	0	.....	0	.....	0	.....
1832 A[2]	5	1.	5	1.01	2	.40	0	.....	0	.....
1832 A[3]	7	1.4	1	.20	0	.....	0	.....	0	.....
1832 A[4]	5	1.	1	.20	0	.....	2	.40	0	.....
1768 A	4	.4	33	3.31	17	1.77	21	2.22	23	2.49
1768 B	9	.9	58	5.85	21	2.25	25	2.74	5	.56
1768 C	1	.1	531	53.16	13	2.78	15	3.30	2	4.55
1768 D	6	.6	773	77.77	6	2.72	4	1.86	1	4.74
1747 A	2	2.	3	3.06	2	2.11	0	.....	0	.....
1747 B	2	2.	15	1.53	1	1.20	0	.....	0	.....
1747 C	0	.....	44	44.00	4	7.14	0	.....	0	.....
1747 D	2	2.	70	71.43	0	.....	1	3.57	0	.....
1847 A	.....	.....	33	3.30	7	.72	7	.73	5	.52
1847 B	.....	.....	44	4.40	19	1.99	6	.64	6	.65
1847 C	.....	.....	39	3.90	58	6.04	10	1.10	3	.34
1847 D	.....	.....	159	15.90	109	12.96	6	.82	4	.54
1847 E	.....	.....	7	1.40	6	1.22	0	.....	1	.21
1847 F	.....	.....	5	1.00	8	1.62	1	.21	1	.21
1847 G	.....	.....	17	3.40	28	5.89	0	.....	1	.21
1847 H	.....	.....	40	8.00	62	13.48	3	.76	1	.25
1768										
1832 C										
1847										

FASTING EXPERIMENTS—Concluded.

Lot No.	Quarters	Weight of Survivors in October			
		Date of Weighing	No. Weighed	Total Weight	Av. Wght
	5 ft. trough			lbs. oz.	grs.
1832 A[1]	August 9—10 ft. trough	Oct. 17	428	8-0	131
1832 A[2]	"	Oct. 17	477	9-12	143
1832 A[3]	"	Oct. 17	486	8-14	128
1832 A[4]	"	Oct. 17	483	9-4	134
1768 A	10 ft. trough	Oct. 16	867	12-5	99
1768 B	"	Oct. 16	808	11-12	102
1768 C	"	Oct. 16	369	5-12	109
1768 D	"	Oct. 16	175	3-3	127
1747 A	5 ft. trough	Oct. 17	96	1-10	118
1747 B	"	Oct. 17	79	1-5	116
1747 C	"	Oct. 17	49	0-17	152
1747 D	"	Oct. 17	28	0-8	125
1847 A	10 ft. trough	Oct. 17	945	4-11	35
1847 B	"	Oct. 17	902	4-3	32
1847 C	"	Oct. 17	879	3-8	28
1847 D	"	Oct. 17	719	3-0	29
1847 E	5 ft. trough	Oct. 17	486	2-10	37
1847 F	"	Oct. 17	479	2-2	31
1847 G	"	Oct. 17	449	2-2	33
1847 H	"	Oct. 17	392	1-10	29
1768	7 to 13 troughs	Oct. 16	3,595	58-0	113
1832 C	2 troughs	Oct. 17	2,411	45-11	187
1847	4 to 8 troughs	Oct. 18	2,986	12-4	29

Fasting Experiments October Weights After Fasting in May or June				Control Lots Oct Weights
Silver Salmon				Silv. Salmon
5 days Fast	10 days Fast	14 days Fast	19 days Fast	Normally Fed
Brook Trout				Brook Trt
5 days Fast	9 days Fast	14 days Fast	19 days Fast	Normally Fed
Lake Trout				
5 days Fast	9 days Fast	14 days Fast	19 days Fast	
Atlantic Salmon in unfiltered water.				At. Salmon
5 ds. Fast	10 ds Fast	15 ds. Fast	20 ds Fast	Normally Fed

Scale of all diagrams;— 1 sq. Millimeter = 1 grain

DISCUSSION.

Mr. Atkins: (Before reading paper.) When I began these experiments in 1905 I did not expect the results which I have found, and I hope you will bear in mind that I tried to be impartial and have everything accurately done, and have tried to be fair, tried not to warp the evidence in any way. I read a paper last year on the subject and now I have something to add.

During the reading of the paper Mr. Atkins made the following comments.

(Showing diagram of size of Atlantic salmon.)

It made no difference in the size of fish in October whether they fasted five or twenty days. So that the early and continuous feeding had apparently done the fish no good. I would not say that it had not done it any good but so far as the weight in October showed it had not done any good.

(Showing diagrams of Atlantic salmon of various sizes resulting from various periods of fasting.)

The control lot of silver salmon was considerably larger than any of the diagrams show.

(Exhibiting diagrams of lake trout.)

These lake trout were fed for six days before the fasting began and then they were made to fast five days, nine days, fourteen days and nineteen days, and the result was that in October the survivors did not differ a great deal in weight. This is average size, and the heaviest was in the case of those that had fasted fourteen days.

(Showing diagram of brook trout.)

Now, here are brook trout in the same way, showing five days, fourteen days and nineteen days fasting.

Dr. Bean: I would like to ask whether or not the starved fish which were submitted to a test of nineteen days, took food readily after the starvation period, when it was offered to them.

Mr. Atkins: Yes, in every case, just as soon as the fish were offered food they appeared to be entirely ready to take it, and in a few days, in every case, they appeared to be picking up.

Dr. Bean: Then these experiments would lead the way to very important practical results, namely, the weeding out of

starvelings or weak fish, and the advantage accruing in long distance transportation of fry.

Mr. Atkins: Yes, sir.

Mr. Clark: I agree with the doctor that it is very important, and I would like to ask Mr. Atkins about those lots of lake trout that were fed six days after they were taken from the tray.

Mr. Atkins: They were fed when they appeared to be ready. We were trying them from day to day and as soon as we found any fish that would take the food, then these fish were fed.

Mr. Clark: In other words, they were of such size that if you were going to distribute fry without feeding, they were ready to be distributed?

Mr. Atkins: Yes, sir.

Mr. Clark: That is the point. I have always advocated that fry should be distributed a few days before the sac was entirely gone. That is the point that I wanted to make. We need not be in a hurry about putting our fry out, and these I understand, were fed six days and then went through the period of starvation.

Mr. Atkins: Yes, sir.

Mr. Clark: In other words, the probabilities are that in the case of these fish that had been fasting nineteen days, and including six days of feeding, about twenty-five days would have elapsed after the absorption of the sac. Do you think that these fish would be in as good condition to plant as fry, as they would if they had been taken without any feeding? That is the point I want to get at.

Mr. Atkins: I hardly know how to answer that. You mean whether these fish after feeding and fasting would be in as good condition to transport and plant as though they had been taken in the very beginning?

Mr. Clark: Yes, sir. Your experiments showed that they were ready to take the food, did so, and grew rapidly.

Mr. Atkins: For instance, the experiments show, they are in

favor of the view, that they would stand transportation just as well then as before.

Mr. Clark: That is quite a point, I think for those who are distributing fry. There has always been such a hurry to get the fry out early, in order that they may find plenty of food either as soon as, or before the sac is entirely absorbed.

Mr. Titcomb: Is not there another point there? I want to ask two or three questions in connection with it. But the first important point is the fact that this fish will stand nineteen days fasting. We will say that you distribute them just as they are ready to take food: a great many people argue that they are very weak and get very little food. We will acknowledge that some of them fast after they are planted, more or less, after the first 19 days. But this brings out the conclusion that that fasting is not going to injure them, as it is a point in favor of fry planting.

I want to ask Mr. Atkins if he sees any advantage in feeding 6 days just before the sac is absorbed, before fasting, or would the other method be best, of having them begin the fast immediately?

Mr. Atkins: I see no advantage in this, but I had heard it said that it was better to avoid any feeding and then interrupting it.

Mr. Clark: That is right.

Mr. Atkins: So I thought I would try that series of lake trout in that way, feeding them a few days first and then making them fast, and they came out in very good shape—in such very good shape that in several thousand there were only two losses in August and two in September.

Mr. Titcomb: Another question: Between the control experiment and the other did you consider the volume of water supplied to each trough as a factor?

Mr. Atkins: Well, not carefully, no sir.

Mr. Titcomb: You gave, of course, a much larger flow to the control trough which had the larger number of fish in it, than to the others?

Mr. Atkins: I suppose that we did, but that matter was only looked at and no measurements were made that I can now recall.

You do not know the volume of water that flowed to each trough?

Mr. Atkins: I cannot state it now.

Q. Don't you think that that is an important feature to consider in a control experiment?

Mr. Atkins: Yes, I do.

Mr. Titcomb: I think these experiments are grand, and are bringing out some very valuable information. Some of you may not have read Mr. Atkin's paper of last year in which he brought out the point that it was not necessary to begin the feeding of the fry immediately after the sac was absorbed or before. Mr. Atkin's experiments demonstrate conclusively to me that there is no necessity of giving those fish any food until several days after they naturally would take it. I should conclude from the experiments that instead of giving food to sac fry in the later stages, as many do, it is a waste of food and not only a waste of food but it is apt to foul the water. You eliminate all that, and the conclusion is reached that it is as well not to feed the fish for several days after they are able to take food.

Mr. Atkins: These experiments indicate that there is no advantage in feeding while in the sac stage, and it would be simply a waste of food and a pollution of the water, and we have another series of experiments in the same line going on this summer and so far as we have gotten with them they are telling the same story as last year's experiments, and the last year's experiments told the same story as some I tried once or twice before, only less carefully; so I feel safe in saying that there is no particular hurry in feeding the fry; if they have to fast several days after they first wish for food, it will not be likely to do them any harm.

Mr. Titcomb: How many days would you suggest, in a general way, should elapse after the sac is absorbed before you begin to feed—from what experiments you have made?

Mr. Atkins: Well now, really, I have not gone so far as to consider that. In fact I have not yet introduced into actual practice any rule which would delay the feeding at all, but I have allowed the fish to be fed as soon as they wanted food, except the experimental lots. I think I ought to study that a little further and see if there would not be a positive advantage in withholding food for several days.

Dr. Birge: Would it not be possible to put screens into the troughs so that the control fish and the fish you are experimenting on, should have each the same amount of water surface?

Mr. Atkins: Wouldn't they have in the same trough?

Dr. Birge: Yes, and as the fish died could you not put in a wire screen, for instance, to cut these fish off from part of the trough, as they get fewer in number, so that you will have just so many fish to the square foot?

Mr. Atkins: Yes, I think that would be worth while, so that as the fish died off the space could be lessened; and then I would hardly expect the same results, because I think the great growth shown by these fish that fasted so long, was very likely owing in the main to having so much extra room.

Dr. Birge: That is true of invertebrates, that they will grow much more rapidly with more space.

Mr. Titcomb: I would suggest that in further experiments you consider the volume of water and make the control experiments exactly alike. Have the dimensions of the trough for each experiment the same, and the volume of water the same; and as you increase the volume with the growth, if you do, keep a record of that. And this suggests what Dr. Birge has said: One thing you want to bring out in connection with this experiment is, what is the actual number of trout of a certain age or size, or other fish, like the salmon, which can be carried in a foot of water to best advantage. That is a point which we ought to be able to publish in our fish cultural books as well as the other. That would come in with your experiments very nicely, I should think.

Mr. Atkins: Yes.

Mr. Clark: I wish that this discussion might continue the remainder of the day. I think here is one of the most important papers and subjects for the benefit of fish culture that has been brought out. I am very glad that Mr. Atkins did not make these experiments and bring this matter to notice twenty-five years or more ago, when they called me the father of the fingerling. He is certainly knocking my theory all to pieces, that it is so much better to plant fingerling fish. I have always advocated that the reason for planting fingerlings instead of fry, was because they were stronger and better able to take care of themselves. However, from the experiments made by Mr. Atkins, even starved fish are ready to take food, and I certainly think that this very important matter should be further investigated, and I trust that Mr. Atkins will continue along the same lines he has so successfully started.

Dr. Bean: I do not see any other paper on this programme in which the question of feeding fry is likely to come up. Therefore I hope you will allow me to make a few remarks about an experiment with brown trout this year. There is always a time in the life of a trout when it will refuse to take food. In fact the mortality among trout is largely due to the refusal of the fish to take the food offered to it, particularly where liver and allied foods are employed. There were cases of this kind this year in May and June at several stations in New York state, and the men in charge, old fish culturists, men of experience, tried in every way possible to induce the brown trout to feed, but without success, until they had arrived almost at the point of death from starvation. Liver was used and whatever other dead animal food of that sort was available, but without success. Then the fish doctor was called in, and naturally, as the species was brown trout, he suggested crustacean or molluscan food. Well, as the crustacean food at these stations was the more readily obtainable, the superintendent was asked to try a variety of shrimp, which was very plentiful, just to take the shrimp, crush them in a sieve, and make an emulsion corresponding with the liver emulsion. This was tried at two stations, and in less than 15 minutes all of the brown trout which had refused to take food were feeding merrily, and the situation was saved. I suppose this has been

done by other fish culturists, but I was anxious to relate it here, hoping it might help some other practical men to save their fish.

Mr. Meehan: Occasionally we have found where fry refuse to take food, that the addition of a little salt would sometimes have the effect of starting them to feed, that is, a mixture of a little salt with liver, not very much, just a little—we found that particularly in the case of some Atlantic salmon that would not feed until we put a little salt in their food, and then they took it with readiness. Whether that would work out all through or not I could not say, but in our hatcheries it did very well with the Atlantic salmon and in one or two cases with brook trout. We very seldom had much trouble with regard to the question of feeding, but occasionally they would not take food, and when they did refuse we found that the salt would help.

Dr. Bean: We tried that method also but without success. We tried another article of food which has been used by a good many members present, salted haddock roe, but that did not tempt them. Nothing but the food which they wanted, which happened to be shrimp, filled the bill.

Mr. Titcomb: The question of salt in the food has come up, which leads me to express the desire that the fish culturists who handle trout will make control experiments, feeding fresh liver and meat which has a trifle of salt in it. Some fish culturists who raise large quantities of Atlantic salmon, brook trout and land-locked salmon, use no salt. I think there is a good opportunity for control experiments there. This is merely a suggestion.

If this subject is exhausted I want to ask Dr. Bean to tell us something more about this brown trout work. We have given up the propagation of the brown trout. We consider that fish objectionable because it is not as good as the brook trout and when placed in the same stream with the brook trout we understand it is so cannibalistic that it eats the brook trout. It is a stronger and larger fish, and should not be planted in any brook trout waters, from our point of view.

Dr. Bean: I do not know just the particular point Mr. Titcomb wants to know about the brown trout work in New York State.

Mr. Titcomb: The extent of it.

Dr. Bean: The extent is much less than it was a few years ago, and the policy of the commissioner is in line with Mr. Titcomb's suggestion, that the brown trout should never be planted in any waters that have brook trout. Beaver Kill River illustrates the bad effects of this method. A friend of mine, a very expert angler, told me he got ten brown trout to one brook trout in the Beaver Kill; the cause of that is unquestionably (at least in the minds of the anglers, and it seems reasonable) that the brown trout destroy the brook trout. If they do not, they at any rate destroy the food of the brook trout, which amounts to the same thing. So that the work of New York now is very much reduced in volume, and there is a continual desire on the part of the commissioner to refuse applications and in fact he does postively refuse applications for brown trout to be planted in brook trout waters. They are suitable for some waters, undoubtedly, waters which contain no other trout, and have done very well there. But this year there is a very grave difficulty with the brown trout, which is no doubt familiar to most of you, and that is the ulcer disease which has broken out in some places, particularly in streams which are polluted with drainage from manure heaps; and it is so fatal that there is a very strong inclination to discontinue absolutely the use of such streams in the future for all race and pond work at stations, believing that unless the head waters can be controlled, so that the cause can be absolutely removed and the waters be disinfected by quicklime or in some other way, it is useless to attempt to remove that bacillus which causes the ulcer disease and destroys the brown trout.

Mr. Titcomb: Does it infect the other species?

Dr. Bean: None except the brook trout. The rainbow trout is immune thus far, but it is very fatal to the brown trout.

Mr. Whish: Once again the lay brother finds a chance to get back at the scientist. We have had in this society several confessions during past years which have evidently been good for the soul, and I have just chuckled over them.

It all comes, in my judgment, from trying to get something foreign in place of something which is native born, believing

that because a thing comes from Europe it is just a little better than anything that grows in America. I was not brought up in any such belief and I do not believe it now.

We had in bird life the English sparrow. I remember when I was a student in the high school, a prize was given to the scholar who would write the best essay on the beauties of the English sparrow which was then being introduced. I have been somewhat of a fisherman ever since I was a little farmer boy with ragged trousers and could get a pin and a piece of string; and I remember when eminent scientific gentlemen threw up their hands and cheered at the discovery of the great carp. I have sat in societies and heard gentlemen of eminence confess—I may say also, confess very carefully—that the introduction of the carp was a fish-cultural tragedy, and I am hearing the successors of these scientific gentlemen confessing very cautiously that the introduction of the noble brown trout is the same thing.

Now this is to me a matter of great glee. (Laughter.) I am a lay brother and I do not know any more science than I have read and I do not know much more science in the fish-cultural line than what I have been taught. But I was told a year or so ago, very cautiously, by a gentlemen of the United States Bureau, that they guessed they would not cultivate any more brown trout.

Now, why don't these scientific men know these things before it is too late?

Our birds have suffered from the introduction of the beautiful sparrow.

President: You don't want a man to know it all at once, do you?

Mr. Whish: It would have been for the best interests of the people at large if some of these things had been known beforehand. That is only my judgment. I hope these things are entertaining to the scientific men.

But here is your carp question: Would it not have been better if they had found out where these fish were suited to go before they put them into the waters of the country? And would not the same thing have been better with relation to the brown trout?

Of what worth is your scientific man if he cannot give proper

advice when great questions of this kind arise? For it is a great question to introduce into the waters of a state, or of a nation, a fish about whose habits you know nothing except as they occur on the other side of the ocean; and however, they may have been on the other side they certainly are different when they get here; and I think (as a lay brother having particular glee in getting back at the scientist again) that in the future, if somebody offers a species of fish that is great and good in another country, it would be the part of wisdom—to try it out in a secluded spot well fenced in, before giving it to the nation at large to the destruction of the better fishes. (Applause.)

Mr. Meehan: I fully agree with Mr. Whish in regard to keeping our indigenous fishes, but I cannot agree with him in laying the blame on the scientific man. From the experience I have had I rather think he has the wrong pig by the tail. My experience has been (and it has covered a great many years in fish-cultural work) that the real offender is the lay brother and not the scientific man.

Going back for a number of years to the carp, which is perhaps the beginning, the real responsibility for introducing that fish rests not so much with the man who introduced it and spoke of it in the first place, as with the people themselves. They heard about it, wanted it and demanded it, and they forced it in many cases against the advice of scientific men. The same thing to my certain knowledge is true in Pennsylvania, at any rate so far as the brown trout is concerned. The anglers demanded it; they said: "Here is a fine fish; we have heard a great deal about this fish, the Isaac Walton fish and the brown trout, and we want it in our streams;" and when the commissioners or those who were responsible refused to give it to them, they went to the members of the legislature, and the members of the legislature went to the commissioner and said: "No brown trout, no appropriation." (Laughter.) That is responsible for the introduction of the brown trout and the introduction of the carp in many places, at any rate, and it is the same thing today in regard to other fishes. I have people, "lay brothers," who have come to me and want lake trout and black spotted trout and black bass and calico bass and rock bass and every other kind of fish, planted in a single

body of water that is only big enough to hold one or two species of fish. I do not think I can lay that on the scientific brother. You have more trouble with the layman than with the scientific man, and that is particularly the trouble in regard to the planting of fish.

Going back to Mr. Atkins' work some years ago, some people began to agitate (and they were not the scientific people) the planting of trout, for instance, in the fall of the year instead of the spring of the year: "because," they said, "the fish have been taken care of in the hatcheries all the summer and they are fine, large size, and can take care of themselves a great deal better when planted in the fall of the year." That bit of poison got all through Pennsylvania, and is not yet out of the system; although our experience has shown that the planting of advanced fry produces best results; but men will say today that in streams where there is better fishing than there has been for twenty years, it would be better to have 250 trout in the fall of the year than 1,500 in the spring,—that is "the lay brother," not the scientific man.

Mr. Titcomb: I believe the subject of fry versus fingerlings is taboo in this society, but I want to agree with the last speaker on the demands of the angler. It is astonishing to see the number of kinds of fish that the man thinks he can get into a small pond. My question to Dr. Bean was put because a great many people today want the brown trout; the majority of them have never seen brown trout and only know it is different from what they have, and they do not want it necessarily because it comes from Europe but they want it just because it is different; the New England people call for rainbow trout, although we have not succeeded in introducing them, after putting millions of them there,—but they want something different. In Pennsylvania the people are learning gradually that the rainbow trout is not very valuable and they are coming back to the native trout. It is the same thing all over the country. They get in one or two kinds and want half a dozen.

Mr. Whish: I only wish to say that it has always seemed to me that the scientific man ought to be a sentinel on the outer works to give warning of the approach of the enemy; and he

ought to know the enemy when he sees him so that he can give this warning. Now in New York state, as Dr. Bean can very well advise you, we have this same trouble about the demand for fish for waters for which they are not suited, but Dr. Bean can also tell you that we do not give these fish any longer.

There was a time when, acting on the conduct, I might say, (not the advice, because I do not think it was asked) of the United States Bureau of Fisheries, carp and brown trout were ladled out very handsomely; but that time is past.

Mr. Titcomb: I want to answer that. (Laughter.)

The brown trout has not done very much damage in this country. We have made the experiment and have discontinued its propagation, except at one station where we are conducting some control experiments on just one wild stream in South Dakota.

So far as the carp is concerned it was first distributed by private enterprise, and later by the United States Fish Commission. While we acknowledge that it was not economical to give those fish to everybody who wanted them for waters in the north, the clear waters of New York and New England for instance, yet today if it were not for false notions prevailing regarding carp, we would be propagating and distributing them in large numbers. The people in the west where they have tanks and mud ponds and small reservoirs, which catch the surface water, beg for carp, and we know the carp will do better in some of those waters than any other species. A recent article written by Leon J. Cole on the carp of the Great Lakes, is well worth your reading, to show what carp is there, and its value; and if you look at statistics you will see that the carp is a very important fish, in the commercial fisheries of this country, especially in Illinois.

Mr. Clark: Has anybody yet, scientist or lay brother, ever given proof that the carp caused any harm? Show it to me if you can.

President: Inasmuch as that brings up a discussion that we have been engaged in for fifteen years, I will rule out the answer. (Laughter.)

Dr. Bean: De mortuis nil nisi bonum! The carp is dead,

long live the carp! The member from Albany answered his own question. He lays the blame for such things upon the scientist, but he forgets, perhaps, that the present administration of the New York Fish Commission is only about three years old, and he is whipping some very much older scientists over the shoulders of the able men who represent New York at present. You might just as well attempt to blame us Christians for not preventing the crucifixion; but we were not born soon enough.

President: It is like a great many cases of death in a great many parts of the country, the doctor was called in too late. We have got them today and they will do work no other fish can.

Mr. Lydell: We have got carp and whitefish and black bass in one pound in the Mill Creek station and they are all doing very well.

Mr. P. G. Zalsman of Paris, Mich.: Of course in respect to putting them in small streams: I deliver rainbow trout sometimes to a farmer and the fisherman says: "Where are those fish going?" "I don't know." "If I knew who was going to put them in such and such a stream I would kill him before he got there. We do not want the rainbow trout in these streams."

Mr. Meehan: There are certain places where they call the brown trout, California rainbow trout. I discovered that recently. People did not want the California trout in a certain county, and when I went there a few days ago a man showed me a fish which he called a "Californian" but it was a brown trout.

President: There is some prejudice against the rainbow trout in Michigan but I think it is uncalled for. It is a different fish, of course, from the brook trout but at the same time, as far as we can observe, it does no harm in the same stream as brook trout. Whether it will do any good or not is another question.

Mr. Meehan: We have found no trouble with rainbow trout as far as destroying other trout is concerned. But apparently they do not propagate very well in the stream.

Mr. Nevin: Rainbow trout do not do very well in small streams, but do well in the larger rivers.

GASES DISSOLVED IN THE WATERS OF WISCONSIN LAKES.

BY DR. E. A. BIRGE, OF THE WISCONSIN FISH COMMISSION.

Mr. President:

When I was listening to the remarks regarding scientists a few minutes ago I felt that the scientist in this meeting was somewhat in the condition of the carp. The sportsmen charge that fish with all sorts of crimes and casualties but when they bring him into court they cannot find him guilty of any of them. So the practical man tries to make the scientist responsible for all kinds of troubles, but when the charge is investigated it comes to nothing. If the scientists had not received so vigorous a defense it would be necessary perhaps for me to apologize for presenting a scientific paper to this meeting, but, under the circumstances, I will give you the paper without apology.

Some dozen years ago, or more, I began to study the life of the lower animals found in the open waters of the lakes of Wisconsin. I carried out one rather large job of that sort and found as I advanced in it that the conditions of life in lakes were not well known. So I then started to take up the study of the physical conditions of life in our lakes. Circumstances that I need not go into greatly increased my duties at the University of Wisconsin and for a considerable number of years made it impossible for me to continue those investigations. Only recently have I been able to take them up again, after long interruption, and to carry them on, although much more slowly than I could wish.

The subject that I am going to talk about today is the distribution of the oxygen gas in the waters of our lakes, and some thing of the effect of that distribution on the lake as a place for animal life.

I must begin with a few words in regard to the temperature conditions of lakes, because upon them the distribution of gas is founded.

Let Fig. 1 represent a section of a lake, and imagine the basin filled with water of uniform temperature, such a condition as

we should find in our lakes in October, November, or December, according to the depth and area of the lake. Now, if the wind

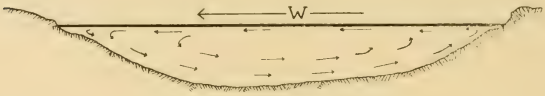


FIG. 1—Circulation caused by wind in lake of uniform temperature.

blows from one direction, for any considerable length of time, it will start a current of water moving in the direction of the wind towards the leeward side of the lake; when the water driven by the wind reaches this side of the lake it has to return; a comparatively small portion passes around the lake; more of it turns down on the shore, comes back at various depths along the bottom, or wherever it may find an opportunity. As a general result, if the lake has a uniform temperature from top to bottom, the mass of water, even though it may be 150 or 200 feet in depth, is set into rotation by the wind with comparative ease, so that the bottom water is brought to the top and vice versa, and a very thorough mixture of the water is made to all depths of the lake. Under these circumstances all the water of the lake is brought into contact with the air and becomes saturated with oxygen.

In the spring after the ice leaves the lakes, the conditions are substantially the same for a little while; the temperature is practically uniform, the water is set into rotation, kept in circulation and aerated by the action of the wind. But as the water warms, the conditions become different; and the warmer water

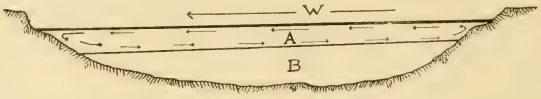


FIG. 2—Circulation in lake during summer. A.—Warm layer. B.—Cool water.

of the surface becoming lighter than the cooler water of the bottom, tends to float upon it. As the days grow longer, the influence of the sun becomes greater and as the nights become warmer, the cooling at night becomes less, with the result that the surface water gets very considerably heated. Under those circumstances when the wind blows the water across the lake, it

does not have energy enough to force the warmer, lighter water down to the bottom of the lake; so that, as the water gets to the leeward side, it is pressed down to a certain distance, but to a certain distance only, a distance depending on the temperature of the upper water, the force of the wind, the area of the lake, and other conditions that I need not specify.

The net result of this contest between the wind, seeking to mix the water and the sun, which tends to keep the lighter water on the top, is that during the warmer season the circulation of the water is confined to a small portion of the lake, a portion which differs in thickness in different lakes. The water moves not along the bottom of the lake but a certain distance below the surface—perhaps 10 or 12 feet down in a small lake, and perhaps 20, 30 or even 40 feet in an inland lake of larger size.

This continued action results in the formation of a comparatively warm layer of water on the top of the lake, within which circulation is going on, and the water of which is more or less continuously turned over and exposed to the action of the air; and beneath that there is a lower layer of water which is cooler, which does not circulate, and which, for a time varying from a month or two in certain lakes to four or five months in others, is shut off from all direct access to the external air by the layer of circulating water on the top of the lake.

You will easily see that the oxygen conditions of the water are very different indeed in these two portions of the lake. The story can perhaps best be illustrated by some of these diagrams, which show in a very general way what goes on in Lake Mendota during the open season of the year.

Lake Mendota, on whose south shore lie the grounds of the University of Wisconsin, is a lake about 6 miles long, 4 miles in width and 84 feet in depth in the deepest portion; several square miles of the lake are more than 70 feet in depth, and the water reaches a depth of 50 or 60 feet pretty close to the shore; the shore is fairly steep, reaching a maximum height of 150 feet above the lake.

Figures 3 to 8 show the temperature and oxygen of the water from April to November, 1905. In each diagram the vertical column of figures represents the depth in meters from the surface down to 22 meters, which is as deep water as you

can find without going too far from our laboratory. The horizontal figures represent two things. They stand, in the case of temperature, for degrees centigrade, and, in the case of oxygen, they

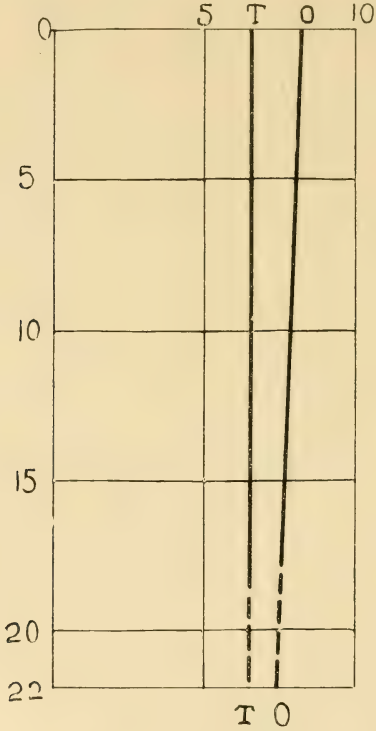


FIG. 3—Lake Mendota, April 22, 1905.

represent cubic centimeters of gas per liter of water; that is, parts per thousand in volume, of the gas in question. The line marked "T" represents the temperature in each diagram and the line marked "O," the oxygen.

In the latter part of April we find a temperature of about 6° C. both at the top and bottom of the lake. There is a very

considerable amount of oxygen, nearly 8 cc. per liter; 8 parts per thousand of volume at the surface and about 7.5 at the depth of 18 meters. I may say that in the early part of the season, for convenience sake, we made our observations in the shallower

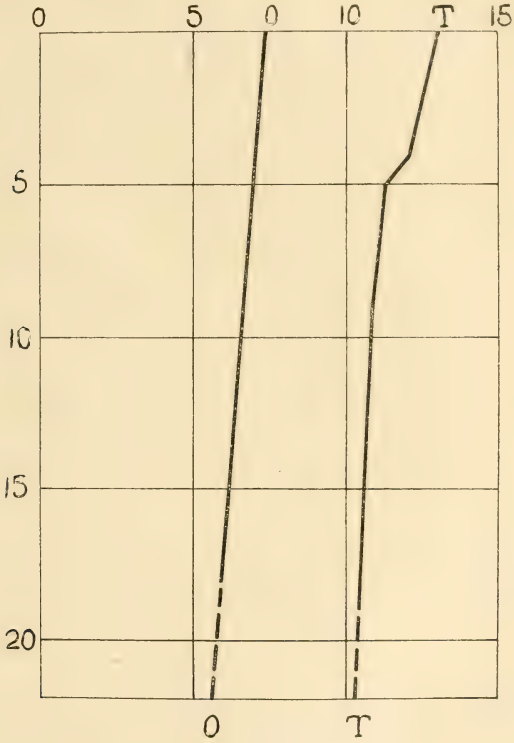


FIG. 4—Lake Mendota, May 24, 1905.

water near the University instead of going a mile or so further to the deeper water of the lake. But the story at this time would be the same in the deeper water, and this fact I have indicated by continuing the temperature and oxygen lines to the bottom of the diagram. In the early spring temperature and oxygen

are substantially the same at all depths of the lake and all portions of the lake support an abundant life.

If now we pass to Fig. 4, which represents the conditions on May 24, you will see that the lake has warmed a good deal—the surface temperature has increased to 13° while the bottom has increased to a little over 10°, but is beginning to lag behind the surface. That shows that the action of the wind is now failing to reach the bottom of the lake, and that as a result the surface is beginning to gain in temperature on the bottom. The amount of oxygen in the surface water has gone down to about 7 cc. per litre; in consequence of the rise of temperature it has declined a little at the bottom, and yet the oxygen line is comparatively straight.

But as you pass into June and July, both as to temperature

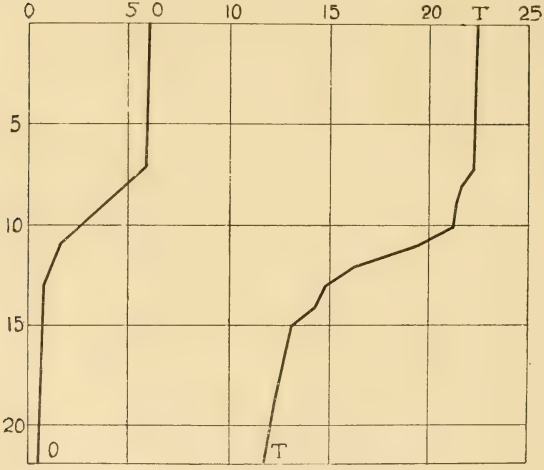


FIG. 5—Lake Mendota, July 29, 1905.

and oxygen the conditions in late July are shown in Fig 5. The surface temperature has risen to 22.6° C, and down to the depth of 7 meters it is almost uniform. At this depth comes a sudden drop in the temperature, which is more marked at 10 meters; the temperature line running down until at the bottom

of the lake it shows 11.8°. The oxygen shows an arrangement corresponding to this division of the lake into two parts; a warm lake 7 to 8 meters in thickness, kept in circulation by the wind and floating on top of the lower water of the lake, whose greatest depth is about 16 meters and which is cut off from the air by the upper stratum. There are about 6 cc. of oxygen per liter in the upper water, but that in the lower water shows the effect of the cutting off of the lower water from new supplies and is nearly exhausted. Its exhaustion is in small part due to the use of oxy-

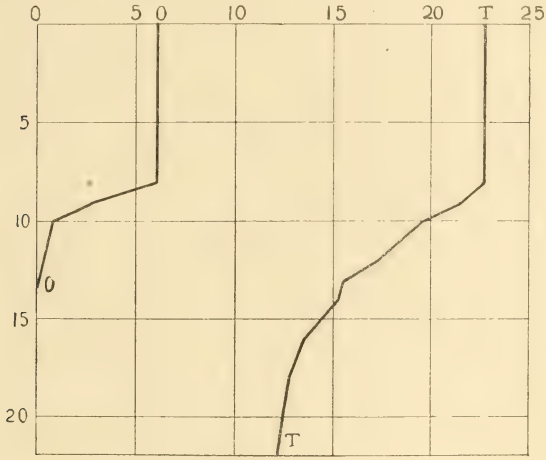


FIG. 6—Lake Mendota, Aug. 31, 1905.

gen for respiration by the animals living in deep water. In far greater part it is used up by decomposition of plants and animals. Down into this lower water are sinking all of the minute dead plants and animals, as well as the larger ones, from the surface of the water; into it is also sinking the debris from along the shore. All of this is decomposed in the bottom water, inevitably using up the supply of oxygen; and that process is showing its effect very plainly from the 7 meter line down. You will see at the 7 meter level the oxygen line begins to curve towards zero and at 13 meters there is very little oxygen left in the water,

(0.8 cc. per liter) and there is even less oxygen at greater depths.

As we pass to the next diagram, (Fig. 6) which shows the facts for the last of August, we find substantially the same arrangement, so far as the temperatures are concerned. The temperature line for the last of August shows pretty nearly 23° C. down to a depth of 8 meters; then comes a rapid fall of temperature, followed by a slower one, until at the bottom a temperature

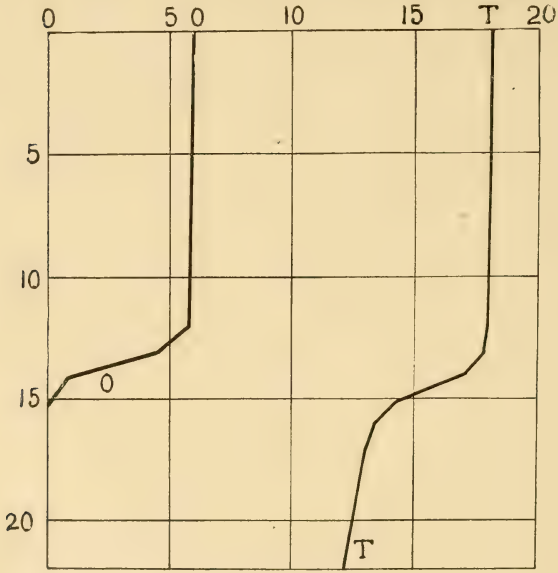


FIG. 7—Lake Mendota, Sept. 26. 1905.

of about 12° is reached. The oxygen of the lower water has been practically used up and ends near the of the cool water.

As the season passes on and the lake cools the upper warmed layer increases in thickness as it declines in temperature. In the latter part of September, as Fig. 7 shows, the circulating part of the lake has reached a thickness of about 13 meters, with a temperature of about 18°. The oxygen has followed on down with

this increase of thickness of the circulating part of the lake—not as fast, since, for reasons which I will not stop to go into, the oxygen follows a little behind the temperature. But the lower, cooler part of the lake is still devoid of oxygen.

In October the temperature falls and becomes practically uniform throughout the lake. Corresponding to this change the

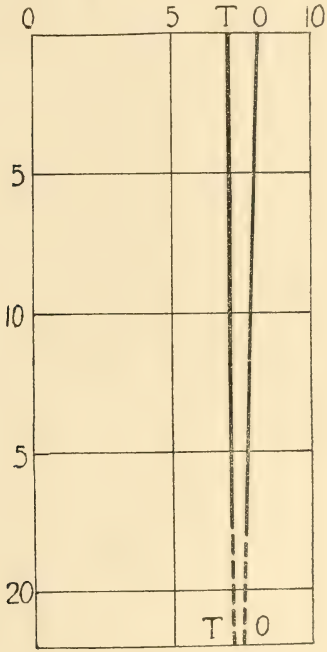


FIG. 8—Lake Mendota, Nov. 9, 1905.

oxygen is found at the bottom of the lake in an amount quite sufficiently abundant to support any sort of animal life. In November (Fig. 8) the temperature has still further fallen, having gone to about 7°., and with the cooling of the water the amount of oxygen which it can hold in solution is increased, the amount has risen to about 8 cc. per liter, and at this time and

later the oxygen supply is rising to its winter condition. In this it will go through the winter and come out in the spring.

The effect of this variation of the oxygen on the life of the lake must be briefly told. My own studies have been entirely on the microscopic life, mainly on the crustacea, though to some extent on the rotifers. If you study the lake in the early spring, when the conditions of temperature are uniform, you will find these animals through the lake at all depths, and in very considerable numbers; and as the spring warming of the lake goes on there is everywhere a great increase in animal life. The algae seem to afford an abundance of food, so that the animal life of the lower types extends to all depths. As the summer conditions come on and as the oxygen begins to be cut off in the lower water, the animal life then becomes, as you would expect, more scanty, and as the July and August conditions succeed, the life in the open water of the lower part of the lake becomes almost extinct. It almost startles the student to see how sharp is the division between the inhabited and uninhabited portions of the lake. If you lower a hose into the lake and pump the water from various depths into a fine net you will catch a great abundance of animals in the water from the lower part of the circulating layer. This stratum indeed is often more densely populated then any other portion and may contain thousands of crustacea and rotifers per gallon. But if the hose is lowered another meter, or even a half meter, an entire change appears. The water is perfectly clear and appears to the eye as fit for life as that above it, but you may pump many gallons of the water without securing more than a very few animals and these mainly sickly or injured forms which have evidently been caught as they were slowing sinking to the bottom. One animal indeed you are likely to find in numbers quite large when its large size is taken into account. Those of you who have studied the animal life of lakes know the transparent larvae of the insect *Corethra,* which is one of the most beautiful and rapacious creatures found in our lakes. This is practically the only animal that you will find inhabiting the lower water. It comes up into the surface water at night, feeds, renews its stock of oxygen, which it stores in sacs, and goes down again for the day into this water devoid of oxygen. In such water it seems to be thoroughly at home and indeed we have

learned that its presence in water pumped from a lake during the day time indicates that there is little or no oxygen in that water.

Thus the story of the oxygen is of great importance to the life of the lake, because during the months of July, August, September, and the early part of October, all the lower part of Lake Mendota is almost uninhabitable by any animal. There are a few creatures that live in the mud; there is found there a species of clam, (sphaerium) about as large as a pea when fully grown. In spite of the fact that the water above it, and around it, is devoid of oxygen, that animal survives apparently in a dormant condition. We have pumped up the mud from Lake Mendota with these animals in it, and kept them under observation in sealed bottles, so that the conditions of life, so far as temperature and oxygen were concerned, were the same as at the bottom of the lake. We found that the animals would continue to live, although in a dormant condition; while if taken out and placed in water which was aerated, the clam would quickly begin to put out its siphons and feed. There are also worms found in the mud, but the life at the bottom is very decidedly scanty and poor, and one which is not fitted to support any considerable amount of fish life at any time of the year.

This story of the oxygen as shown in Lake Mendota is repeated in principle in all lakes; but the details of the story, and the effect upon life are very different in different lakes. All of the lakes get during the late fall, before they freeze, practically as much oxygen as they will hold at the temperatures which they have reached; they come out in the spring with substantially that amount of oxygen. The formation of the warm surface layer comes at different times in different lakes. In the small lakes it comes early in the spring, late in April, or early in May. In lakes of 20 or 30 acres the warm layer will be formed at that time and the bottom water is then cut off from access to the external air. In lakes of a mile or two in length this formation comes late in May or early in June, and at that time the lower water will be cut off. In the larger lakes from 6 to 8 miles long, like Lake Mendota, Lake Geneva or Green Lake, the final formation of this layer is still further delayed until the latter part of June or

early July; so the bottom water is cut off from access to external air for very different lengths of time in different lakes.

And still further: The amount of the oxygen in the lower water depends not merely on the length of time that the bottom water is cut off from the external air, but it depends also upon the amount of decomposable material discharged into it by the upper water and on the volume of lower water, which depends on the depth of the lake. If the amount of life in the lake is small, the amount of material which will decompose in the bottom water is extremely small, and the exhaustion of the oxygen goes on with corresponding slowness. If the volume of the lake is great, as in Green Lake (237 feet deep) the amount of oxygen is correspondingly great, and it is not rapidly used up. If the lake (like Mendota) has an enormous amount of plant life in the upper water, so that there is a continual and rather rapid rain of organic matter dropping down in the lower water, decomposition goes on rapidly, aided also by the comparatively high temperature of the bottom water, and the oxygen is exhausted at a comparatively rapid rate.

Then again, in case of the smaller lakes, the amount of discomposable matter coming in from the margin of the lakes increases proportionately—the smaller the lakes the larger the margin with reference to the volume of the water of the lake. There is a zone around the edge of any lake in which the bottom plants will grow. This zone does not differ in breadth in proportion to the size of the lake, so that in a small lake the central part which is free from bottom growth is much smaller proportionately than in the larger lake, and the material washed into the deeper water from the margin and the banks is correspondingly greater in the smaller lake. Then, too, the leaves which are blown into lakes of 20 or 30 acres in area, or even larger, form a very important addition to the decomposable material on the bottom. The result of all this, in those small ponds and lakes so common in the kettle moraine of Wisconsin, is that the bottom water is cut off from access to oxygen at an early period in the spring, and a great amount of decomposable material of all kinds is present in the lake. It follows that there is a long period during which there is no oxygen in the lower water, and consequently no animal life, and the bottom of the

lake is composed not of mud but of partially decomposed organic material in which no higher organisms are able to live.

I have indicated in diagrams, some of the conditions which we find in certain of these other lakes, to show you some of the variations which may occur.

I will speak first of Green Lake, which resembles much more nearly the condition found in the Great Lakes than does any other inland lake of Wisconsin. This is a lake of some 8 miles in length, 2 miles in width, with a depth of 237 feet. It is 100 feet deeper than any other inland lake in Wisconsin. The life of the lower water of Green Lake is not very different from that of one of the Great Lakes, and when we note the oxygen story, we can see some reason for this fact.

Fig. 9 shows the distribution of temperature and oxygen on September 6, therefore comparatively late in the summer season. You will notice that in this diagram each vertical space stands for 10 meters instead of 5, as in the case of the other lakes, while the horizontal scale is the same as in the other diagrams. The lake shows a temperature of about 21.5° C at the surface, falling slightly to a depth of 9 meters, and then declining rapidly to about 20 meters. From that point to the bottom the decline is slow until at a depth of 70 meters a temperature of 5.7° is reached. I may say in passing that there are no lakes in Wisconsin in which the bottom temperature remains at 4° C during the summer. Even in this lake, 237 feet in depth, the bottom temperature is always greater than that of the maximum density of water. The action of the wind in the spring is sufficient to circulate the whole mass of water and to give it an opportunity to warm up a degree or two above the temperature which gravity alone would give it. The distribution of oxygen is quite different from that shown in any of the preceding diagrams. At the surface the amount is about the same as in other lakes and there is a marked decline in the oxygen at the upper part of the cool water. Then the oxygen begins to increase, becomes greater than the amount found at the surface, and at the depth of 40 meters is nearly 7 cc. per liter. From the depth of 50 meters it declines, until at the bottom only a fraction of a cubic centimeter is left. This abundant supply of oxygen in the lower water depends on the great volume of this water in comparison to the amount of

decomposable matter discharged into it. The water absorbed large quantities of oxygen during the fall and winter and only a part of this stock has been exhausted, most rapidly at the bot-

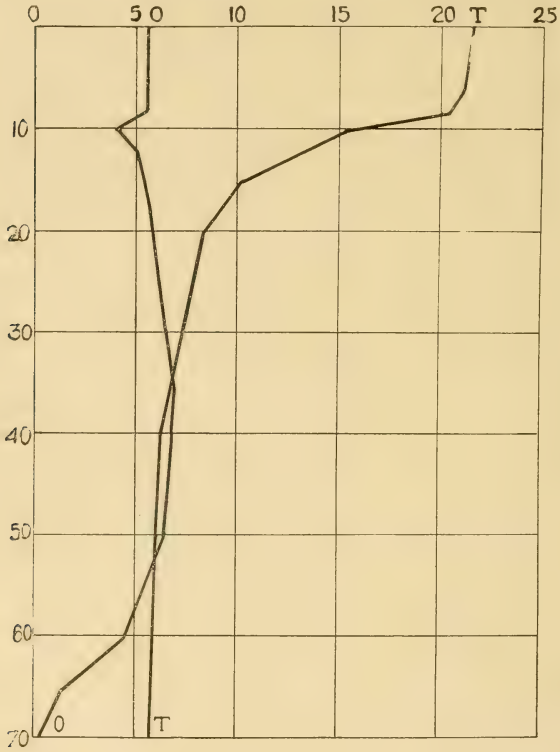


FIG. 9—Green Lake, Sept. 6, 1905.

tom and at the upper part of the cool water—the two places where the greatest amount of chemical activity seems to take place. The oxygen nowhere becomes so low as to make it impossible for a considerable number of animals to live in the water and in the mud beneath it.

Green Lake is the only lake in Southern Wisconsin in which an oxygen curve of this character could be drawn. In most lakes the bottom water is practically devoid of oxygen in September.

In Lake Mendota the whole of the cooler bottom water becomes oxygen-free at a comparatively early period of the summer and there is a long period there when the lower water cannot be utilized by animals. If this statement were true of all lakes, the smaller lakes would have only a very shallow surface stratum which could be utilized. But in many smaller lakes an operation goes on which materially increases the amount of oxygen and the thickness of the stratum of water which is inhabited by animal life. Figure 9 shows the distribution of oxygen found on August 16 in Beasley Lake.

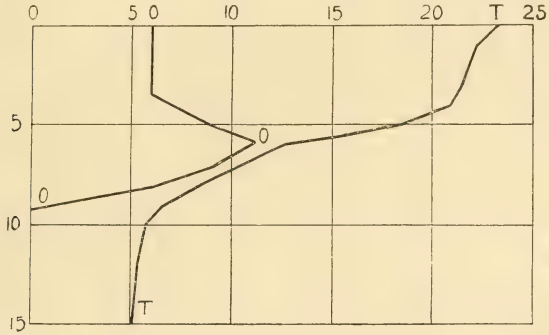


FIG. 10—Beasley Lake. Aug. 16, 1905.

Beasley Lake is a little lake about one-quarter of a mile long and half as wide, a kettle-hole, one of a chain of lakes at Waupaca, in central Wisconsin, and one which shows, by the way, about as low bottom temperatures as any Wisconsin lake. You will notice that the temperature of the water begins to fall at a depth of 4 meters, or only about 13 feet below the surface. You will see also that the oxygen curve does not follow the temperature curve as it does in Lake Mendota, but that instead of decreasing the oxygen increases in the cooler water, so that at a depth of 6 meters there is a very large amount—11.2 cc. per liter. At 8 meters there is still as much as at the surface but

below this depth it rapidly declines until a little below 9 meters no oxygen is left. This lake gets from the surface water and from the shore a great amount of decomposable material and one might expect that the oxygen would be very promptly exhausted up to the top of the cool water, especially as the warm upper stratum is formed early in May or even late in April. The diagram, however, shows that the facts are very different and that the upper part of the cool water, so far from being poorer in oxygen than the upper stratum, has a much larger amount. The cause of this great amount of oxygen is as follows: The transparency of the water is such that the algae of the water can grow at a depth considerably greater than the top of the cold water; and these algae, lying as they do in the water which is not distributed by circulation, the cool water lying below the warmer stratum, get light enough to utilize as food the carbon dioxide and the other products of decomposition that come to them, and they liberate free oxygen as a result of that process. Thus we get in the upper part of the cool water not merely the normal supply but an over-saturation of oxygen, an amount which could not be held in the water at all if that water were at the surface. In this way the thickness of the layer of water which is available for animal life is practically doubled by the presence of the oxygen which is manufactured by the plants.

The diagram of Elkhart Lake, Fig. 11, shows the same thing. This is a lake about 110 acres in area, and 112 feet in depth, 34 meters. The upper stratum, the layer of warm water, is about 6 meters in thickness, and the temperature falls off very rapidly from that depth. At 6 meters the oxygen begins to show an increase; at 8 meters a maximum of oxygen is reached amounting to more than the 11 cc. per liter. It does not begin to fall off very greatly until 10 meters have been reached, and even at 12 meters there is still a somewhat abundant supply. From that point it declines until it practically reaches zero, although it does not get absolutely to zero at any point in this lake—at least not in August, so far as our observations go. So that in this lake also the stratum which is available for animal life is by this action of the plants increased from a thickness of perhaps 6 meters to 12 or more meters.

How great an effect the condition of the gases may have on lakes can perhaps be well illustrated by a lake whose gases have not yet been investigated. Mr. Hankinson who is studying Walnut Lake in Michigan, has been telling me today of the results

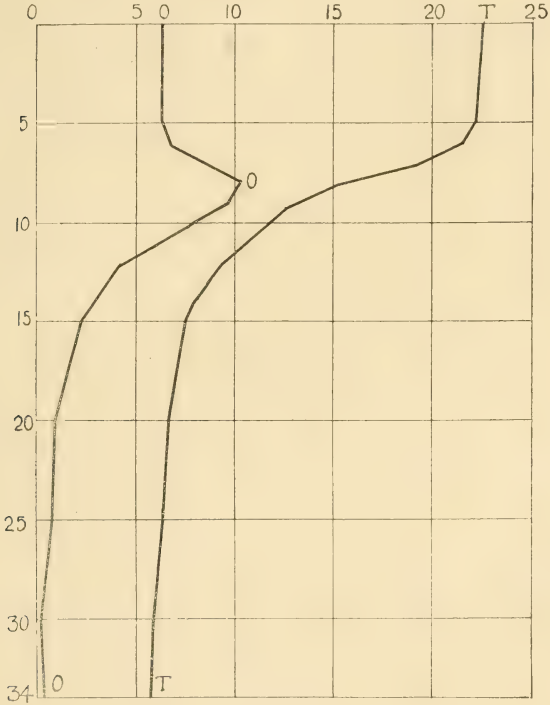


FIG. 11—Elkhart Lake, Aug. 23, 1906.

he has found in the study of the life of that lake. The lake is about a mile in length and half that in breadth, and 110 feet in depth. It is a lake that is not far different in these conditions from Rainbow Lake, Okauchee Lake, Nagowicka Lake and numerous other lakes in Wisconsin.

In Walnut Lake as I am told, the bottom is very thickly

covered with insect larvae which are living in the mud and feeding on the lower organisms which live at all depths, and both insects and lower crustacea supply food for fishes. I think the true whitefish is found in fair numbers in this lake. Now our southern Wisconsin lakes lack oxygen in the bottom water; insect larvae, therefore, cannot live at the bottom. Oxygen is cut off from the lower water early in July and does not increase there again till October; and the result is that the bottom waters of our lakes are poor in life, and there is no possibility of raising in these lakes those fish that must live in cool water and must find in the deeper parts of the lake a large supply of food and air.

I have added another diagram (Fig. 12), showing the distribution of oxygen and temperature in Trout Lake, as found by us during the present season and which perhaps shows conditions a little like those of Walnut Lake. This lake has a depth of about 100 feet, with a length of about 4 miles, and a breadth of 2.5 miles. It is in two parts, however, which are connected by a narrow opening only. The diagram is taken from the southern and larger portion, which is about 2 miles long, divided by islands into two or more basins. In this true whitefish *(Coregonus)* and lake trout are found; the latter inhabiting the deep water during the summer. The diagram shows that although the oxygen declines in the lower and cooler water, it declines very slowly and that there is a considerable amount until the very bottom of the latter is reached. Down in the oxygen-poor water at the bottom lake trout are able to live, as our observations have shown. There is a marked contrast between the oxygen content of the lower water in this lake and that of any of the lakes of similar depth in Southern Wisconsin, and this difference is probably due to the very small amount of animal and vegetable life found floating in the open water of Trout Lake. Very few lakes in Northern Wisconsin have been examined carefully, but Trout Lake is the poorest in this respect of all the lakes which we have studied.

The oxygen and other gaseous conditions of the water in general and of the bottom water in particular, are prime conditions of life, which determine not only the lower life but the possibilities of the higher life of the lake also; and for this reason I

have brought the story thus briefly to your attention. The whole subject of the gases dissolved in the waters of the Wisconsin lakes is being studied by the Wisconsin Geological and Natural

FIG. 12—Trout Lake, Sept. 7, 1906.

History Survey. We began the study last year and the field work is continued during the present season. We shall expect to publish at an early date a full account of the results of our investigations.

Mr. Titcomb: I want to ask Dr. Birge if he has in any way observed the movement of fish with reference to the changes in temperature of the depths. Take for instance, the lake trout which inhabit the very deep waters in August, and in June, we will say, is in four feet of water or near the surface.

Dr. Birge: I have not been able to follow the fish. As yet we have not had money enough to chase both gas and fish at the same time.

Mr. Titcomb: One more question: This is a subject that interests me a good deal because I have for a long time had a great desire to locate a hatchery with a lake as a water supply for the propagation of salmon and trout, and have an unlimited supply of water from the lake. Now almost every trout and salmon lake that I know of gets too hot on the surface, and it would be practically impossible to take surface water from even a trout lake of large area and supply a hatchery to rear fish in the summer time. My idea was to regulate the temperature, possibly varying it to suit conditions by taking it at varying depths. I am surprised to see there is so little variation in the first 8 meters, because I have tested lakes where there was much more variation in less depth, but this brings in the subject in such way that when we consider a water supply of that sort we must go into it more fully than I had thought, and consider the supply of oxygen and action of gases, as well as of temperatures.

Dr. Birge: The depth to which the warmth of summer will extend is primarily a function of the size of the lake. Of course granting that the lakes are in the same general region. A lake further north will not be as warm as one further south; but in the case of lakes within 50 miles of each other, the larger the lake the thicker the warm layer will become, as you will see, when you understand it depends primarily on the action of the wind.

You will notice in the diagram of Lake Mendota the cold layer starts at 8 meters and goes down to the bottom. In Elkhart Lake, which is only 110 acres in extent, the warm layer s about 5 or 6 meters in thickness; and in Beasley Lake the warm layer is only 4 meters in thickness. The warm layer in August in this lake is about as thin as you can find it in anything you

can call by courtesy a lake. A lake of 15 or 20 acres will show as thick a layer as that. So that you have got to go deeper than that for cold water. If you think of using a lake in the way you speak of, you ought to visit the lake in August or in September, and ascertain what the gas conditions are in the lower water. In the cool water from Lake Mendota, the fish will die quicker than on land. If you put a fish into this water and keep him where he cannot get his mouth out, and get air, and he will keep his gills working with the result that the oxygen will get out of his blood instead of going into it; whereas, if he were out on land, he would simply wait until he had used up himself all the oxygen which he had. There are other gases which develop in the lower water, but so far as I know, those gases are not directly poisonous to animal life. The carbon dioxide does not seem to affect the animal life directly. But the question of the amount of oxygen is very important. You could pump water out of the deeper waters of Green Lake, for instance, to supply a hatchery and it would be perfectly satisfactory, so far as oxygen is concerned though I am not sure that you would not be troubled even in that water with an excess of nitrogen.

Mr. Titcomb: That would readjust itself quickly in flowing on the surface.

Dr. Birge: Yes, but the water would also become warm. It is a question whether you could get rid of excess nitrogen without warming the water more than you want to.

Mr. Titcomb: On a rapid current a stream does not warm up very quickly.

THE FISHERMAN AND REFORESTATION.

BY FILIBERT ROTH.

That the forest cover influences the distribution of water on the earth's surface in place and time, that the forest helps to store up water, and tends to make our streams more ample, more clean and more regular, preventing flood and drought, all this is matter of common belief. That this belief is held by at least a part of the members of this society, I take for granted, otherwise the matter of reforestation could have no place in your discussions. It is to be regretted that this relation of forest and waterflow should still be a debated question anywhere, and that we should lack reliable and accurate data to substantiate the commonly accepted belief. This is the more unfortunate, since we, right here in Michigan, have had perhaps a better opportunity to trace, step by step, the changes brought about by the removal of the forest, than is found in almost any other part of the world. And even today these changes are going on; springs are drying up along our Huron River banks, little streams are changing to dry runs; wet fields are gradually drying up; thousands of acres of swamps are changed to meadows, miles of corduroy road are thrown out and changed to dirt road. Even in our north counties, where no clearing, no settlement has helped matters along, we find old cedar stubs on what is now dry sandy pinery land, clearly showing that when the forest was intact the moisture loving Arbor Vitae had no trouble in growing out of the regular cedar swamp. But these facts were not recorded, they did not lend themselves to easy and yet accurate observation like temperature and rainfall and the consequence is that we have to go and see and infer.

In considering the action of the forest in regulating the distribution of water we may assume as proven by the experiments of Wollny and others that:

The forest holds the soil, it prevents the erosion as no other cover does. The great significance of this one action is difficult to overrate.

The forest serves as a mechanical barrier to a ready surface run-off. The forest keeps the ground in a more receptive condition and thus facilitates the soaking in of water.

The forest forms a large "brush cover" acting like an artifical cover of any kind, and thus reduces the action of wind and sun. The forest is a shelter house and thus produces conditions which tend to preserve moisture, exactly as the walls and roof of a green-house do.

That the forest as a mass of growing plants also uses up moisture and thus wastes exactly what we claim that it conserves, is understood.

Keeping these facts in mind, it is clear that a forest covered area may be regarded as a reservoir, that the greater this reservoir, the more moisture and vice versa. Also that if all land is forest, there comes a time when equilibrium is reached, and that if all forest is removed there will finally come a condition of equilibrium, in keeping with these new conditions.

Our prairies and some of the large provinces of China are perhaps in this cleared land-equilibrium. A hundred years ago Michigan was in a state of equilibrium as to water distribution and especially in the southern half, it was rather too wet for safe and comfortable human habitation. Since then the surface has changed, a large part of the forest is gone, the surface run-off is made easy by cleared land, furrow and ditch, and we are gradually approaching another equilibrium, probably less satisfactory than the first. The gullying and washing of our lands, flood and drought have caused people to become alarmed at the prospect of drifting into an unsatisfactory extreme and the municipalities affected by floods, the water-power men and other industrials like yourselves have joined hands with the forestry people to see if the matter might not in some way be modified and serious losses averted.

Believing in the influence of the forest, the reforestation of denuded lands naturally suggests itself as one of the most reliable means.

To the fisherman this reforestation is of importance in various ways and to various degrees. To beautify the stream and landscape, to shade the water and affect its temperature; to keep

the waters clear and pure, and lastly but most important of all, to keep a steady flow.

Even a narrow fringe of forest along a stream will lend beauty to the landscape and suffices to shade the stream if small. But to keep the waters clear and pure more must be done, and still more is necessary to regulate its flow and maintain an ample supply of water. At this point we still make the mistake of supposing that the reservation of a few townships at the head of the Arkansas is going to regulate its flow. This is a fallacy and should be avoided. Every little helps, and it is gratifying to see any attempt made, but for final success it is necessary to be clear as to the truth in the case. To regulate the Grand River and have it as it was 100 years ago, all the land tributary to the stream should be woods; and to have a decided influence in staying its erratic behavior more is needed than merely a few acres of woods at one or a few of its sources. How much is needed? No one knows; but so much is certain, the condition of every acre of land tributary to Grand River has its influence however, small, on the magnitude of the flood or the duration of a drought. What is true of Grand River is true of every stream, modified by the many conditions peculiar to each.

But will reforestation prove a feasible means? Certainly, but in most cases it will mean a task of some magnitude, and to underrate this is a sure beginning of a failure. Many conditions necessarily enter the first considerations of such problems. In Iowa where ninety per cent. of all land is real plow land, reforestation must remain in the background, and the plow receive a first consideration. In New England where probably not over thirty per cent. will ever prove proper plow land, the case is reversed. The same comparison holds between Wayne county and Crawford county, or the upper peninsula.

Generally it may be said, the mistake is made in our country in overestimating the value of the agricultural uses of the land. The clearing and settling craze is still on, and we are apt to forget that much land may be of far better use if left as woods, or restored to forest. In our own state we have dozens of fine streams running through lands on which the state has been losing money trying to force settlement. Such areas ought to remain

forest, the bare lands should be restocked, and timber and water, fish and game should have their proper attention.

Once a project of this kind is decided upon, the methods of doing are simple. But here again let me warn against half doing. If we go into it let us make sure that the tree we plant receives the protection without which all forest growth is impossible. It is useless to plant forest and then burn it up.

With every larger enterprise it pays to survey and map the land, maintain a home nursery and raise the needed plant stock, and in all cases have a man trained to the business. What to raise will depend on the land. On better lands the hard woods have the advantage of being useful early, of sprouting and thus saving expenses in starting new growth. On our sandy lands, and also in handling the Northern swamps the conifers are the principal trees we must look for.

The expense of starting a forest is usually much overrated. Five dollars per acre will do very well, and ten dollars is an ample outside allowance.

On larger areas the protection of the lands should receive close attention, and in no case should this be left to a mere "put out fires" enterprise. Patrol, rigid, regular, and ample patrol is the only satisfactory method. But will this pay? Always! provided we apply a reasonable amount of forethought and economy. The little tree costs less than a cent to put in the ground, it is worth at least one dollar when fifty years old. But here let me warn against rash expectations. Forestry is not a speculative, promoters' business; it is a form of agriculture, and though generally the safest form, forestry, like other branches of this business, pays only a modest per cent on the investment. Nevertheless, if the state of Saxony can make five dollars per acre per year net, we ought soon to make one-fifth or one-third of this, and thus do better than that continuous failure performance of would-be farming on poor land.

Reforestation in our state, as in many others, is needed and must come. It is a great problem and a problem which needs thorough consideration from all standpoints. For its success it needs considerable legislation and recognition on the part of our statesman and local authorities. It needs notification of the atti-

tude of state to its own and private property, and it needs much education among our people.

To bring these about it needs concerted action on the part of all those interested in this subject, and it is for this reason that I thank you especially for this opportunity of saying a word with regard to the greatest economic problem before our people.. (Applause.)

NEW TYPE OF JARS FOR HATCHING.

BY W. E. MEEHAN.

Some superintendents of hatcheries in Pennsylvania were not perfectly satisfied with the type of jars used for hatching and asked me to try to design something more satisfactory.

I designed a jar which is now in use in some of our batteries, and I believe is in use in one other state and is giving entire satisfaction. There is no patent on the device. There is no contraction at the top, the lip is much larger than in the other jars and wider, and the stem is done away with and a simple plate of glass set on the bottom. The bottom is round and formed like the bottom at the McDonald. This jar will hold as many eggs as the Chase or Downing jar, and more than the McDonald, and can be set up close to the battery. The jar not needing as large a lip as is necessary on some jars, because of the body being perfectly straight, allows the jar to set close to the trough; the amount of water required is not so great as is necessary in certain types of jars. A small amount of water will keep the eggs moving very nicely. We have been using it in our hatcheries with very great success and the men believe it to be better than some of the types that we have been using heretofore. One other state also has been using it with marked success.

Mr. Clark: What is the difference between that and other jars; I cannot see it.

Mr. Meehan: The Downing improved comes in this way:

The McDonald jar is shaped something like this:

which makes it difficult to clean, and so with the Chase jar.

My jar is shaped like this:

It is much easier to work and wash than other shapes are, and holds a maximum amount of eggs, which work more easily and regularly than any other jar excepting the McDonald, at least so my superintendents aver.

Dr. Bean: The state of New York has a few of the new jars referred to, and the men who are using them like them very much. They say that they are easier to clean, they stand closer to the battery, as Mr. Meehan said, and they increase the capacity of the hatcheries by about 20 per cent. for the same water.

THE BASS AT THE MILL CREEK STATION.

BY DWIGHT LYDELL.

In a letter from our Honorable Secretary, a couple of weeks ago I was asked to contribute something in the way of a paper, no difference how brief, and as to briefness I think I have you all faded.

The bass at the Mill Creek Station are now in the pink of condition, but this could not be said of them last spring. One year ago last month we lost the most of the S. M. stock fish at the Mill Creek Station by flood. What few were left (about 20 in number, were transferred from our regular breeding ponds to a much larger pond, for the reason that the breeding ponds had to be kept dry for some time in order that a cement wall might be built to protect us from farther damage by flood.

After transferring what few breeders there were left, other stock was procured from outside waters and placed in the same pond, but we were never able, until this spring after the spawning season, to control these fish, or in other words, get them to come to any certain point to feed, in fact they had no food except what was in the pond, this consisted possibly of a few crawfish. The outcome was that they were in rather poor condition when the spawning season arrived this spring.

From the first spawning about 60 of the 78 beds in the pond, were covered with eggs, these I have no doubt would have come through in good shape only for cold weather that drove the temperature of water from 62° down to 47°, where it stayed for two days. The outcome was that the bass deserted their nests, and the whole business went up in smoke. Probably from this spawning there were 300 fry hatched. Why these 300 escaped I do not know, and was too disgusted at the time to try and find out.

After the water had warmed up again another spawning was found to have taken place, about 40 beds being covered with eggs. These seemed fairly good, but the adult or parent bass were so blooming hungry by this time, that they turned in and ate up

nearly the whole lot of eggs, rooted up the nests, and raised cain generally, only 6 good nests coming from this spawning.

Fearing that the small mouth work at the Mill Creek Station was going a glimmering for 1906, I became desperate, and upon learning that S. M. were being taken at Newaygo, from the Muskegon river, Mr. Otis Monroe, the foreman at the station was sent at once to that point. He returned with 20 nice specimens, which were placed in a spawning pond, and beds placed therein. These fish had not spawned when we put them in the pond, and have not yet done so to my knowledge.

About the time that the fish were secured from Newaygo we learned that some S. M. were being taken below the dam here in Grand River. I immediately hied myself riverward and secured twenty-six more S. M. specimens. These fish were little fellows, but healthy looking chaps, and as soft as mush. Twenty of these were placed in one of the smallest spawning ponds at the Station and six were put into one of the regular spawning ponds. From the twenty in the small pond we got seven as nice beds as I ever saw. They spawned the next day after being placed in the pond. From the six that were put in the regular spawning pond we got two nice beds, one pair spawning on the plank at the outlet, and the other pair spawned on the roots of an old stump that was left in the pond when it was built. They spawned before we had time to put in the gravel. This is the first time that I have ever got any fry from S. M. bass introduced into the ponds in the spring, and I think that if these had been put in two weeks earlier nothing would have come from them. The latest that S. M. have know to spawn at Mill Creek occurred this year, one nice bed coming off the 22nd of June.

The stock fish at the station are now in excellent condition, and are feeding nicely on liver, so we expect to get back into the old channel another year and do business again.

The Large Mouth at Mill Creek have covered themselves with glory this season, and nothing farther could be asked of them. They commenced spawning in the fore part of May, and continued to spawn until the middle of June.

An experiment was tried in feeding some L. M. advanced fry this season that will no doubt be of interest to some of you. Five hundred of these fish all about ¾ of an inch long were

counted into a screen and placed in a small narrow pond, with a good current of water running through the screen. These fish were fed entirely on the so-called Chicago fish food, (showing sample). They were fed nearly every hour for 10 days, when those that had not starved to death were so weak that they could hardly swim, so I concluded that as far as Chicago was concerned it is out of the race for the present as to food for L. M. bass fry. I intended trying many other experiments in feeding bass of this length, but, my time being taken up with shipping and other work, could not get to it. If there are any members here who have tried feeding these fish as fry, would be pleased to hear what success they have met with.

The output from the Mill Creek Station this season up to July the 14th is as follows:

Small mouth No. 1 fingerlings.....	8,000	
Small mouth No. 2 fingerlings.....	31,500	
Total.....		39,500
Large mouth, advanced fry.....	474,000	
Large mouth No. 1 fingerlings.....	318,000	
Large mouth No. 2 fingerlings.....	21,500	
Large mouth yearlings.....	1,004	
Total.....		814,504
Grand total.....		854,004

We still have 1,000 yearlings to ship and I think 50,000 a fair estimate of what fingerlings there are left in the ponds. None of the ponds has been drawn off, so it is somewhat hard to tell.

DISCUSSION.

Mr. Titcomb: Do I understand he got 800,000 and odd bass from this station this year?

Mr. Lydell: That includes three auxiliary ponds that you do not see here.

Mr. Titcomb: As large as these?

Mr. Lydell: Yes, two of them larger than these.

Mr. Titcomb: It is extremely good work even then. The

superintendent of the Manchester Station actually tried an experiment which I attempted but failed in through not having my ponds in proper order. He placed his bass and fry when they rose from the bed, in nursery ponds of the size of about 75 x 20 feet. They had not been in use and contained a great deal of natural food and the fry fed on this natural food in these nursery ponds until they were sufficiently large to take maggots. Then he suspended the maggot trays over the water and the little bass came up and assembled under the trays and took the maggots greedily. He does not know yet how many fish he has caught there, and that would be a very important point. At the St. Johnsbury Station there are a lot of nursery ponds much smaller than those mentioned, which had no fish in them, and when I was there I noticed that those ponds were filled with animal life early in the spring, if they were left empty of fish; and we wanted to try the same experiment there. There is a good idea in that, in getting your small mouth bass spread out to get food, and still have them under control.

Mr. Meehan: We tried maggots with some success at the Wayne hatchery. At Torresdale we had ponds about 30 feet by 15 feet. There was a large quantity of live food in those ponds and in addition to that the fish were fed with ground fish which they took very greedily, four times a day. But neither maggots nor natural food seem to have reduced cannibalism very much. We placed 14,000 fish in those ponds and at last accounts we had taken out 3,000, and there were left about 2,000.

Mr. Clark: They talk about maggots on which to feed small fish, but they do not mean for feeding the fry just after they come off the nest. What has anybody tried as to feeding fry as they come off the nest?

Mr. Seymour Bower: You mean for feeding with artificial food?

Mr. Clark: Yes, or doing anything to increase the natural food—that is where we are weak. In this connection I might say that this season we put 10,000 fry directly from the nests into one pond at Northville, and counted 8,325 number two fingerlings.

Mr. Mechan: That is better than I did in mine.

Mr. Nevin: Last fall at Dousman where we have no buildings and no tanks, when the fry commenced rising off the nests, we got two big farm tanks, 10 feet in diameter, and placed these below the dam and ran a pipe from the pond into the tanks, and with one lift of the net we could raise up half a pint of bugs, and we would put a tubful in the tanks and the fry would go after the bugs like brook trout go after liver. We did that two or three times a day; it was just like fattening a lot of hogs. We did not lose any fry, they fed well. There was an abundance of food and from this pond we shipped 600,000 large mouth bass, and expect to ship 400,000 more.

Mr. Clark: What kind of bugs were they?

Mr. Nevin: A good deal like the common louse.

Mr. Titcomb: Is it daphnia?

Mr. Birge: No, but of the same group.

Mr. Nevin: The pond was filled with them. At Minocqua station many died from scarcity of food and we could not hold them any length of time, but had to ship them as soon as we brought them in.

Mr. Titcomb: On this subject of food of that sort, there is a great field for investigation. Mr. Atkins has tried experiments with manure to produce this minute animal life. It does produce it, and ordinary refuse and straw will produce it, and the killing of the algae with copper sulphate will increase the daphnia and cyclops, for a time. We had an interesting experience at the fish pond in Washington this year, where one small pond had been enclosed for a number of years to keep a pair of fancy Mandarin ducks. It had never been cleaned out, and the ducks had occupied the pond every summer for a number of years; we found this year that we could gather this daphnia, bucketful after bucketful every day, for two or three weeks, and possibly they are doing it still; that food is suitable for the bass when they are ready to take food. That is the kind that we want to encourage I suppose, in this nursery pond project which I suggested, leav-

ing the ponds natural, and possibly putting in manure of some kind until we introduce the little fish where nature has already provided food which carries them along until they take something larger.

Mr. Lydell: We have no trouble here in getting plenty food for the fry. The trouble arises after they become an inch long, or a little less; that is where we lack for food. Our food was most plentiful this year in ponds which had been dry during September and October. Those ponds this year were one teeming mass of daphnia. We put in our small bass fry and after they were three-fourths of an inch long they cleaned up the mass and then they lacked food.

Mr. Titcomb: That is where maggots would come in.

Q. Do you keep any of your ponds dry through the winter?

A. No.

Q. Just through the fall?

A. We had to run them dry on account of putting this wall in—that was the only reason.

Mr. Titcomb: I have heard of a food used called the Chicago food, and I would like to inquire what that is.

Mr. Meehan: It looks a little bit like Indian meal.

Mr. Lydell: Yes.

Mr. Meehan: We tried it on trout and it bound them up like a bullet.

Mr. Lydell: We had some bass in the same pond; there was a nice current formed through the screen and by stirring this food up it went down this current and looked as much like daphnia as anything you could get, and I thought it would be quite valuable, but these bass would just give it a wise look and walk away, and they would starve to death before they would take it.

President: Are there any further recommendations of this Chicago food?

Mr. George Morcher: This is my second year in which I have used that Chicago food, but I use one-third of middlings and two-thirds of meat.

Mr. Meehan: This is a powder, is it not?

Mr. Morcher: Mine is a little coarser than corn meal, but fish under an inch and a quarter in length wont take it; after that my inch and a quarter fish, as long as I keep them confined at the hatchery, take it readily, and with no bad results.

Mr. Titcomb: Bass?

Mr. Morcher: Yes.

Q. Large mouth or small mouth?

A. Both. The small take it more readily than the large. If I put in a school to-day it makes no difference how many insects I have, I grind a good butter cracker, about as fine as corn meal, and on the outer edge of the pond I drop that in here and there and it floats. I have watched bass which would not eat until they were ten to twelve days old and they will go right to eating, and they will follow you along and pick this cracker up. Now I feed them about fourteen days on that same size of ground cracker, then I begin to put in a larger cutter, until they get to be about one and one quarter inches long, and then I use Chicago meat with these middlings. I cook it in the morning, cover it up in a tight vessel and let it set until four o'clock in the afternoon, and feed from four to six p. m., two men taking it around, using it for all spawners as well as fry, and I do not think anyone could have had a nicer lot of fry in small-mouth bass than I did last year. From the 10th of May up to the 15th of September they grew from two and a half to seven inches; and there were 150 taken out of there from four and a half inches to seven inches long—and I must praise the Chicago meat.

Mr. Titcomb: You cook it in with middlings?

A. Yes.

Q. How long do you boil it?

A. Just long enough to get it thoroughly stirred through. I get a farmer's kettle and it holds fifteen gallons. We have to

put in enough water to the meat to make it just the same as your wife makes mush out of corn meal—thick and a little crumbly. Where we feed it to small bass we take it in our hands and loosen it up and scoop it up over the water. The bass, catfish and croppy fry or fingerling pick it right up as they go, and they fatten on it.

Saturday evening we had something peculiar happen. I was walking along after the men had fed the fish. They practically had got through, and I passed a small mouth bass pond where I had this in, and as I was walking along noticing the west pond I saw a fish coming out of the deep water. He made a dart for the shore, and when within a foot of it whirled on his head with his mouth open and darted around. I asked for a cheese-cloth net and caught him and found he was dead. I examined him and found nothing on the outside that showed any signs of injury. I took him up to the house where I had a strong glass and examined him again and found nothing. His scales were as bright as could be; he measured two inches; his stomach was not overloaded but nice and full. I took my knife out and opened him and examined his gills, but there was nothing there and nothing in his throat. I opened him from one end to the other and I found undigested food, that he had just swallowed, and food that he had in his stomach and was digesting. I know it was not the Chicago food that caused his death, because that was not digested. What killed him I don't know. There was only one thing peculiar, and whether that was natural or not I cannot say —the food was a little bit gummy. But there were hundreds of fish right around him that ate that, and that is the first of it that I discovered. My opinion is he was caught by another fish, was too large to be eaten, got away, and died from the effects of it, but when I found no marks, I used a strong glass on him and even then I could not find anything; but I cannot blame the Chicago meat, because it would have affected the others, and I think I have got as plump a lot of fish as anyone.

Mr. Titcomb: You drew your pond in September to get those fish?

A. Yes sir.

Q. And the fish were not sorted in the meantime?

A. No sir—the water was too deep.

Q. How many did you get out of this pond?

A. Fully 100,000. I put 200,000 in, but my loss I attributed to the extra large bass that were in there.

Q. How large a pond have you?

A. I think it is about 200 by 170 feet wide.

Q. You refer to the small mouth bass?

A. Yes. I can raise more small mouth bass in the same amount of water than I can large mouth.

Q. What was the average temperature through the summer?

A. I have not kept the full temperature record; but my temperature has, in the lower pond, run up as high as 90°. In my spring pond, where we used altogether spring water, it never exceeds 60° one hundred feet from the main spring.

Q. The one you had 100,000 in?

A. That was 78° Sunday.

Q. You have a constant flow of water through that pond?

A. Not as heavy as it is here in Mill Creek.

Mr. Clark: Did you take 100,000 out towards the fall?

A. The 15th of September.

Q. Out of a pond 170 by 200?

A. Yes—it may be 250—but those fish were fed twice a day, and any quantity of insects were in there. The fish were just estimated—I had a net when I delivered to the car, and I counted that net full, and I use so many nets full to every bucket or every can that goes to the car.

I might add that we raise not only bass but catfish.

Mr. Titcomb: What kind of catfish do you cultivate?

Mr. Morcher: Marble cat. Where they get them from I don't know. They were gotten by a man that had a hatchery in Waverley. The state rented it of him for ten years. Then I took hold of the London hatchery and moved them there.

Mr. Titcomb: Have you ever tried the speckled cat?

A. No, we have tried the channel cat, but cannot keep them.

Mr. Lydell: I went to Mr. Morcher's station about this time last year and he certainly has one of the greatest propositions for bass I ever saw, though they do not ship any bass during the summer, but wait till the fall. Of course, they do not have the waters to look after that we do in Michigan; the lakes are so very scattering that a few carloads of fish take care of nearly all the inland waters, I think.

Mr. Morcher: Last year we furnished all applicants, but the year before we did not, and everybody seemed to be well pleased, except a few wanted all bass and got some catfish. Then I had plenty of them to put around in Madison county where I get my own fall and winter food.

Mr. Bassett: I would like to ask Mr. Morcher what he knows about the quality of the flesh of fish when prepared for the table, where this food, or other prepared food, is used, as compared with those fed on liver.

Mr. Morcher: I cannot say. I have had no experience in that line.

I had a misfortune last year in emptying one of my ponds. I think Mr. Lydell saw the fish. There were 170 in the pond, small mouth bass. We went there June 5th, about 6 o'clock in the evening, and I wanted to get this water on the inside of the fence, so that none of the fish would be caught with the seepage out of it during the night, and I drew from the top of the water to the bottom of the pond, six and a half feet, but left three and half feet of water in the deepest part of the pond. I also was very cautious about getting the moss, cutting out these runways to the deep water, and all around the outer edge, to prevent my bass from getting in there and getting choked up, for I had a large quantity of hatching tubs in there. Now this was in September, I think about the 20th, at the time of the first frost we had up in there. At 6 o'clock I left the pond seeping water from springs coming in from all directions, but no waters running from the upper pond, but plenty to maintain 170 fish with the amount of water they had. I went back the next morning a quarter to

seven—I did not get home till 10 o'clock, and the men were a little ahead of me. I went up to where I let the water out and found my bass piled four deep, some dead, some part dead, some just breathing yet. I called the men, and I don't know whether I lost my head, or what, but I waded into it, and began to throw them out. I just took them over to the next pond and did everything I could to revive them and I saved out of the 170, 38. After I got my pond cleaned out I put the dead fish into the ice-house and examined them. I looked down their throats and found they were plugged up with mud and moss. I opened them and found the entire stomachs were full of mud and moss. The only theory I can give for the death of those fish was that these little minnows in this pond went down into this deep water in the morning at four or five o'clock, and these old fish discovered them, and they banked these little fellows two feet out of water on the bank, and tried to get them, going after them with their mouths open, and they would catch the bank and filled themselves up with this moss and mud, for their stomachs were full of it. There was none out in the deep water; the water was not a bit roily; but there they lay all on a pile, in a row twenty feet long, and wherever I found them I found the little chubs lying up on the bank. Now if anybody can give me the reason for the death of those fish in so short a time, I would like to know it.

Dr. Birge: What became of those that you put over into the other pond.

Mr. Morcher: They were all right.

Mr. O'Brien: How many thousand do you carry on a car?

A. Seventy thousand or seventy-five thousand. We have eleven large tanks in each car. Then we generally fill a number of cans and have them in the aisle to deliver at the first station.

Mr. Titcomb: I hope Mr. Morcher will count his fish next fall. I do not believe he is carrying so many as he thinks. We carry as many as we think we can carry safely, but we cannot do any such work as that. I think the only way to settle that is to count them.

LETTER ON THE PROPAGATION OF BLACK BASS.

BY HENRY W. BEEMAN.

Success in the propagation of the small mouthed black bass, I am led to believe will be assured only by the closest attention to all the details entering into the work, and unless one is willing to devote his entire time and best energies of both mind and body to the enterprise success will not be forthcoming. We have demonstrated beyond all doubt that the fry can be brought to the advanced stage with the greatest degree of success and we are thoroughly convinced that they are as valuable for stocking purposes then as at any time. To carry large numbers of the advanced fry in small ponds and attempt to raise them to fingerlings is another proposition, although our method of feeding for fingerlings produces most vigorous fish, that actually make more rapid growth than when in the wild state; the difficulty in raising considerable numbers in small ponds is due directly to the peculiar habits and characteristics of the fish. It is natural for them when they have arrived at the advanced stage to scatter, each individual going by himself, and to crowd large numbers into small ponds will usually result in at least partial failure. Nature is quite likely to assert herself, and the fish become rapidly reduced in numbers until the size and condition of the pond in which they are confined shall be sufficient to meet their requirements. Finally our experience leads us to the conclusion that better results are secured by carrying the fry only until the advanced stage of growth is made, at which time the wily watchful and secretive habits peculiar to the bass are fully developed and if planted where sufficient cover is at hand, the greater part will survive.

It is a great disappointment not to attend the annual meeting of the American Fisheries Society. My time is so fully occupied with my duties here at the hatchery there is no time to write a paper nor to attend the meeting this year.

ASSORTING BROOD BLACK BASS TO PREVENT CANNIBALISM.

BY J. J. STRANAHAN.

Experience has taught at Cold Spring Station, Bureau of Fisheries, that there are in all our ponds individual large mouth black bass which are specially cannibalistic and it is the intention of the writer to remove all such in future as fast as discovered, even resorting to the rifle to get them when necessary. But he believes that all large mouth black bass, and presumably small mouths also, should be assorted into the ponds in as nearly the same sizes as is practicable, the large ones into the larger ponds and so on, it being desirable, where that number of ponds is available, to make them up into at least four or five grades.

The larger bass are necessarily more logy and less active in their movements and therefore unable to protect their young from the raids of the smaller and more active individuals. They are also much less prone to cannibalism, in fact it is a rare occurrence to see a bass weighing four or five pounds or more feeding on the fry in our ponds.

When the smaller fishes are by themselves all are equally active and a one-pound male will defend his brood so vigorously that even the specially voracious individual soon finds that he can not run amuck among the fry at pleasure without suffering the consequences and cannibalism is reduced to a minimum even among the smaller and more bloodthirsty classes.

Of course, a station must keep up its brood stock by either raising a supply from year to year or by introducing wild stock and by this system of sorting this growing stock can be made useful from two years old and later, while, in our opinion they would be far better kept by themselves and not reproduce at all than to place them with the larger fishes.

It has sometimes been argued that such assorting as above recommended will result in a disproportion of the sexes. We do not believe that this argument is tenable. We have observed some of our largest bass this season guarding nests and pro-

tecting broods and, while it is probably true that there is a preponderance of females among the very largest bass, this is not enough to break the force of our position as to assorting, for if perchance there should be some loss through the disproportion mentioned, it would be many times made good by the beneficial results obtained by a rigid segregation of the sizes.

There is another reason, and a strong one, for thus sorting the fish. The young and growing fish should be fed more and oftener than the large ones. Feeding of the large fishes during breeding season to prevent cannibalism is entirely unnecessary while the smaller ones, both for their healthful growth and to mitigate cannibalism during breeding time, require more frequent feeding. This change will save feed and labor but the more important feature is that of saving the adult fishes for a very large percentage of loss among our larger fishes, those which should be in their very prime for reproduction, is caused by what in the case of the human being would be called fatty degeneration, if we may judge from general appearances, the organs being covered and obscured by fat, the liver being yellow, when cut in section, from an accumulation of this material. When by themselves the larger fishes could be fed more sparingly and this loss through excess of adipose could be at least measurably lessened.

In concluding the writer would give it as his opinion that where the fishes are properly assorted as to size a larger number could be successfully carried in a given area, for one of the reasons that numbers should be restricted is that the fish interfere with each other while the parents are caring for their broods, this generally being done by the smaller adults rushing into the schools and devouring numbers of the fry, separating them and very often breaking up the schools before they would naturally segregate. Under normal conditions at this station the schools will hold together until the fry have attained a length of one inch or one and one-eighth inches but we often find broods broken up into several small schools when they are half that size and this is generally caused by the raids of the small adults. Of course, unprotected by the parent fish, these will perish unless taken out and shipped, which is our universal practice.

DISCUSSION.

Mr. Clark: The point in his paper is good, that when the bass get large, weighing four, five or six pounds, they do not begin to do the damage in a pond containing fry that yearlings do.

Mr. Meehan: Our experience has been that we have to get them in in the fall and if we put them in in the spring we cannot do a thing with them.

Mr. Lydell: One lot I put in this spring, did not do anything, and the second lot I put in in the evening and the next afternoon they spawned. We got such good results because they were so near spawning that they could not help themselves.

Mr. Meehan: It is a curious thing, because I had the experience with the small mouth bass that if we did not get them in in the fall we could not get anything out of them at all.

Mr. Clark: We had small mouth bass at Northville that spawned six or seven days after they were put in, wild fish brought from the Saginaw River.

Mr. Nevin: In regard to building bass ponds, are you building large or small?

Mr. Lydell: Ponds number three, five and one are my regular breeding ponds. The large ponds are for large mouth bass and for rearing. I had to take them and transfer them to number seven, where I left them for breeding this year.

Mr. Titcomb: How many adults did you put in number three?

A. Fifteen or eighteen pairs. I have been reducing the number of adults to the pond ever since I began propagation, and get better results all the time.

Mr. Clark: If you had just the kind of place you wanted and could do just as you wanted, would you have large ponds for rearing bass? Would you prefer half an acre, three-quarter's of an acre or ten acres?

Mr. Lydell: I do not think I would have a pond larger than 300 by 150 feet. I think for rearing exclusively, if your pond

is so you can control it and clean it out in the fall, it makes no difference whether it is 100 or 1,000 feet in diameter. I do not see that it makes any difference, only that the ponds of the sizes that we have here are very much handier than larger sizes would be. When you commence to ship you can clean that pond and ship your fish, whereas in a big pond you have got to draw the whole pond down in order to get the fish anyway, although you may not want all the fish.

Secretary Peabody: You remember Mr. Beeman told the association that he had discovered that the female bass spawned several times during the season. What is your judgment about that now?

Mr. Lydell: I never have actually seen the female bass spawn the second time. I think however that some females do spawn a second time. I know a female bass will spawn partly on one bed and go to another bed with another male and spawn there.

Mr. Titcomb: Both small and large mouth bass?

Mr. Lydell: I am speaking of the small mouth bass.

Mr. Nevin: Do you think roily water affects them?

Mr. Lydell: I think so—if it is during the spawning season.

Mr. Nevin: In the Mississippi River it is very roily, and that seems to make no difference.

Mr. Lydell: It will drift in here and settle on our beds an inch and a half deep in one night.

THE BEST PAINT FOR SCREENS.

BY MR. LYDELL.

Last year the question was asked in regard to a paint to keep screens from rusting. This season we have used here at the Mill Creek Station an article put out by the Sherwin & Williams Co., called the Sherwin & Williams Pure Atchison Graphite Paint. We have found that if fills the bill better than anything yet used. The company lent us samples (showing screens) coated with one, two and three coats. The number of coats on each screen is indicated by these small white marks on the corner (indicating); one mark, one coat, and so on. You will notice that in bending the screen up it does not break the coating.

Mr. Nevin: Do you think it is better than coal tar?

Mr. Lydell: Ten to one. You can put it on more quickly than tar.

Here is a screen with one coating on it which has been in use all summer long; it was put in a pond the first of May and taken out last week.

Mr. Bassett: What is the address of this firm?

Mr. Lydell: You can buy it at any hardware store in the United States. The cost is something like $1.50 a gallon, and the name of the paint in full is Sherwin & Williams Pure Atchison Graphite Paint.

TUBE FOR AERATING WATER.

President: One of our overseers has developed an appliance for his own use which I think is very valuable and we shall be very glad to hear Mr. Price explain his device, which consists of a tube for aerating water.

Mr. John L. Price, Drayton Plains, Mich.: This is what we have named an aerating tube for aerating water in carrying fry and advanced fry in cans. (Demonstrating apparatus.)

It is provided with four quarter circle holes operated by a valve at the top. An extra bottom is put on to keep the fry from being sucked into the inside of the tube and injured in that way. Now by raising the valve and slowly settling the tube in the can, it is filled. In lowering the tube exercise care to avoid touching the bottom of the can with the bottom of the tube. On the inside there is a guage so that when the can is filled within an inch of the top the guage shows you one inch of water between the bottom of the tube and the bottom of the can, so that there is no danger of injuring the fish.

When the tube is filled you raise your finger, raise the valve and that lets the water out. The extra bottom is fitted with a valve, and when you raise the valve above it closes that and forces the water to a circle, acts as a reducer and gives it force. This is provided with a screen and prevents the fish fry getting in there. The tube will fill in ten seconds, and empty in five, without injuring any kind of fry.

The tube holds just a gallon and three-quarters of water, and five applications of the tube practically empties a ten gallon can and it takes the water from the bottom of the can and aerates it on the surface. For carrying wall-eyed pike, shad and white-fish, we put another bottom on provided with a finer screen, and that prevents the sucking in of the fry, and you get the same results.

You can use it for a pail for a fresh supply of water, and it also takes the place of a siphon.

REPORT OF COMMITTEE ON FOREIGN RELATIONS.

BY MR. CHARLES G. ATKINS, OF EAST ORLAND, ME.

The Committee on Foreign Relations in submitting its first report begs to presume that it was not expected that a single report, or two or three reports, could cover the whole field. Indeed, it needs but a cursory examination of the exhibit of the matter made by correspondence already in hand and by accessible publications to show that it would be impossible to exhaust the subject, or even to keep fully up with the new matter of interesting and instructive character developed from year to year in foreign experience within any limits that would not swell the volume of annual transactions beyond practicable size. It has therefore appeared to your committee best to attempt no exhaustive treatment of any branch of the subject, but to endeavor to submit a series of brief summaries of the organization and system of fish cultural work in foreign countries together with a more minute treatment of such branches of the subject as may promise to be most helpful to American fish culture.

In illustration of the world-wide interest in fishery subjects may be cited the successful organization at Paris in 1900, of the system of International Fishery Congresses by the appointment of a permanent International Commission, the original composition of which embraced members from Germany, Austria, Switzerland, Italy, Spain, Portugal, France, Belgium, Holland, Denmark, Norway, Sweden, Russia, Roumania, Great Britain, Japan, the United States of America, Mexico and Chili. The most of these countries have engaged in actual fish cultural work.

The most important sources of information on this subject, outside of official reports, are perhaps the fishery periodicals of the world. A list which may not be exhaustive shows the existence of three such periodicals in France, one in Belgium, two in Switzerland, one in Austria, one in Sweden, one in Denmark, one in Finland, and six in Germany. The German periodicals alone present the reader with over 3,000 pages of fishery litera-

ture annually. And this statement does not include the reports of experiment stations or the great mass of matter appearing in sporting journals, as in the United States and Great Britain.

Of fish literature other than official and periodical we may get some idea from the list of new matter published from time to time by the Bulletin of the Central Aquicultural Society of France, which quotes in a few recent issues twenty-one titles of works pertaining strictly to fish culture; twelve titles dealing with aquarial natural history; seven titles of technological works; and fifteen titles of works dealing with fish and fishing in a general way.*

The first step taken by your committee in its inquiry into foreign fishery matters was the issue of a circular** covering the subject quite fully; and it is mainly from the information thus elicited that the statements relative to the status of fish culture in various countries have been made up.

The foreign notes herewith submitted cover work and condi-

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*See detailed lists below.

**The circular of inquiry reads as follows:

Information desired by the Committee on Foreign Relations of the American Fisheries Society regarding fish cultural conditions in foreign countries.

1. Does the Government engage in the artificial culture of fish?

2. What is the name of the bureau or department having immediate charge of fish cultural matters, and how is it officered?

3. Please forward any publication in which this work is officially considered.

4. What species are artificially propagated?

5. At what ages are the various species distributed?

6. Number and location of stations for fish culture maintained by the Government?

7. How many of the above have been established within the past five years?

8. What sums exclusive of salaries of regular employes are annually expended in the artificial culture of fish?

9. What salaries are paid to officers and employes of various ranks in the fish cultural service?

10. What are the total expenses for salaries of permanent employes?

11. How many fish of each species were distributed during the last fiscal year? A table of distributions of the various species for the past four or five years would be much appreciated.

12. What have been the general results from the artificial propagation of fish?

13. What is the sentiment of the general public in regard to the value of fish culture?

14. What exotic species of fish have been introduced, and with what results?

15. Please state the number of private fish cultural establishments now in operation. Of these what number have been established within the past five years?

16. What are the principal species of fish handled at such private establishments, and what is the approximate annual output of (a) eggs, (b) fry, (c) brood fish, (d) fish for market?

17. Names and addresses of any societies or associations for the furtherance of fish culture or any other fishing interests?

tions in Canada, Peru, Chili, Argentina, New Zealand, Tasmania, England, Scotland, Holland, Sweden, Finland, Japan and China.

CANADA.

Fish breeding was conducted in Canada, previous to 1868, on a very limited scale as a private enterprise; but during the year above mentioned the work was taken over by the Federal Government. From one hatchery this work has been extended as circumstances would permit until today there are thirty-two fish breeding establishments in operation throughout the Dominion. Those erected of late years are of modern structure and are equipped with the latest appliances.

The Federal Department of Marine and Fisheries has control of all public fish breeding establishments in Canada. The work connected with the Fish Culture Branch is supervised and conducted by the Superintendent of Fish Culture, subject to the approval of the heads of the department at Ottawa. The branch is officered by the Superintendent of Fish Culture, Secretary, and Inspector of Hatcheries, located at Ottawa, and the permanent officers-in-charge of hatcheries residing in or near the establishment under their supervision.

The work up to about three years ago was devoted entirely to the hatching of the commercial species but public demands for the sporting varieties became so strong that operations to a limited extent were begun in this direction. The species now operated with are as follows: Pacific salmon, Atlantic salmon, salmon trout, grey trout, lake whitefish, pickerel, speckled trout, ouananiche, small-mouthed black bass, shad. In addition lobsters are incubated in several establishments on the Atlantic coast.

Until recently the various species have been distributed in the fry stage. Three years ago a rearing pond for Atlantic salmon was constructed in connection with the hatchery on the Restigouche River in New Brunswick in which the fry is retained until they are about six months old. This system has been very successful, but, owing to the heavy expenditure and the difficulty of securing suitable locations for rearing ponds, this branch of the work is being cautiously extended as occasion offers.

There are thirty-two establishments throughout the Domin-

ion maintained by the Federal Government and located as follows:

Province of Ontario: Ottawa, Sandwich, New Castle and Belleville.

Province of Quebec: Tadoussac, Gaspe, Magog, Lac Tremblant, St. Alexis and Lake Lester.

Province of Nova Scotia: Bedford, Margaree, Windsor, Bay View, Canso and Forchu Lobster Pond.

Province of New Brunswick: Restigouche, Miramichi, St. John River, Shippegan, Shemogue and Carleton Pond.

Province of Prince Edward Island: Charlottetown and Kelly's Pond.

Province of Manitoba: Selkirk and Berens River.

Province of British Columbia: Fraser River, Skeena River, Granite Creek, Harrison Lake, Rivers Inlet and Pemberton.

Twelve establishments have been put in operation in Canada during the past five years.

The sum of one hundred and twenty-six thousand dollars is spent annually in the artificial culture of fish. The Superintendent of Fish Culture for Canada receives two thousand two hundred dollars per annum. The Inspector of Fish Hatcheries, one thousand and two hundred dollars per annum. The officers in charge of hatcheries are paid in accordance with the importance and responsibilities of the several stations and the salaries range from five hundred to one thousand two hundred dollars per annum. The assistants are paid from one dollar and fifty cents to two dollars per day according to the nature of the work performed. The salaries of permanent officers amount to about twenty-four thousand dollars per annum.

The attached statement gives the numbers of each species distributed during the past four years.

It is generally appreciated that the money expended by the Canadian Government in the propagation of fish has been well spent and the returns to the public, both from a commercial and a sporting standpoint, have been eminently satisfactory. Fish Culture in Canada meets with public favor From all parts of the Dominion applications for the extension of this service are continuous. No better evidence of popular opinion is required than a comparison of the amount appropriated by Parliament for

Fish Culture, which in 1895-96 was forty thousand dollars. This amount has been gradually increased from year to year until in 1905-06 the grant is one hundred and fifty thousand dollars.

No exotic species of fish have been introduced into Canadian waters, operations being confined to indigenous species.

STATEMENT OF THE NUMBER OF FRY DISTRIBUTED IN CANADIAN WATERS DURING FOUR YEARS, 1902 TO 1905.

	1902	1903	1904	1905
Atlantic salmon...	9,857,000	7,348,000	8,373,500	9,114,000
Pacific salmon.....	15,974,000	17,818,000	13,560,000	16,772,000
Whitefish	108,000,000	81,000,000	82,500,000	105,500,000
Pickerel	15,000,000	21,000,000	24,000,000	26,000,000
Salmon trout.....	2,460,000	4,618,000	2,575,000	3,530,000
Speckled trout....	10,000	65,000	16,000	514,000
Rainbow trout....	.....	71,500	98,000	50,000
Grey trout.....	.....	.....	.....	260,000
Lobsters	120,000,000	181,000,000	337,000,000	463,000,000

The government of Peru has contracted with Mr. R. E. Coker, a graduate of Johns Hopkins University and a former employe of the Bureau of Fisheries, to conduct biological observations along the coast with the view of investigating not only the marine fisheries but the guano industry and make recommendations as to the advisability of changes in the laws for the protection of fish and the protection of guano-producing birds. The purpose of the investigation is not only to increase the supply of commercial fishes but also to take measures to protect the food upon which the guano-producing birds live. Mr. Coker will also make investigations with the view to the introduction of oysters.

Some inquiries have been made with reference to investigations in the fresh waters of the country. Although under tropical skies the fresh water streams and lakes of Peru are fed by glacial waters, and many of them are at an elevation where the climate is temperate rather than tropical. Lake Titicaca in Peru and Bolivia is the highest navigable lake in the world and its waters are undoubtedly cold enough for the introduction of some desirable fresh water species of fish from the temperate zone. It is of interest to know that the present inhabitants of this lake, at an elevation of about 12,000 feet, are all of marine origin. There are many lakes including the headwaters of the

Amazon of which the impression has prevailed in Peru that the waters are too cold for fish life. Some of these would undoubtedly prove congenial to some of the species of Salmonidae.

CHILI.

Attempts at fish cultural work in Chili have been conducted for a number of years under the direction of Frederico Albert, Chief of the Seccion de Aguas i Bosques del Ministerio de Industrias. It appears that on two or three different occasions previous to the administration of Mr. Albert the Chilian government obtained shipments of salmon eggs without making preparation for their reception in the country. Consequently when the eggs arrived in Chili after a long journey they were a total loss

Carp were introduced into Chili a number of years ago with disastrous results. Mr. Albert reports that after they were introduced the trucha and pejerrey which abounded in the streams of Chili became very much diminshed in numbers. He attributes the diminution to the fact that the carp devoured the food upon which the native species subsisted, and states that the carp themselves were not a success and that they became a thin and bony race of fishes. His report indicates that the species acquired more bones than the usual number, but it is inferred that this is not the case. The bones became more prominent as the fish became reduced in size and flesh. In addition to the carp, tench, calico bass, and goldfish were introduced but no information has been received as to what effect, if any, was produced by their introduction.

During the year 1903 quite an extensive salmon station was constructed near Los Andes During the past year 300,000 fishes six months of age were distributed from this station, consisting of Atlantic salmon, rainbow trout, brown trout, and steelhead trout, the eggs of which were all obtained in Europe. It is too early to report any results from fish cultural work in Chili, however. While the people in general can not yet appreciate the value of fish culture, it is regarded as of great importance by the government. There are no private fish cultural establishments in the country.

ARGENTINA.

As the Society has already been advised, this work was inaugurated by the Argentine government in the fall of 1903, when Mr. John W. Titcomb was employed to make investigations. Mr. Titcomb was in the country seven months during which time he traversed portions of it lying between latitude 25 degress and 43 degrees south. He constructed the first hatchery in South America and before leaving Argentina, eggs of various species of Salmonidae had arrived and had been successfully hatched. The government has organized a division of fish culutre in the Bureau of Animal Industry of the Department of Agriculuture, for the support of which $35,000 paper money ($15,418.50 gold) is annually appropriated for salaries. The chief of the division of fish culture is Mr. E. A. Tulian, a member of this Society and formerly superintendent of the United States Bureau of Fisheries Station at Leadville, Colorado. The government provides for a second chief and the necessary number of superintendents of stations. At the present time, besides Mr. Tulian three fish culturists from the United States have entered the employ of the Argentine government. The following list shows the assignments of eggs furnished the Argentine government from the United States and the results secured from them.

Year	Species	No. Shipped	Per Cent. Hatched
1904—	Brook trout.....	103,000	82
	Lake trout.....	50,000	95
	Rainbow trout.....	§100,000	..
	Steelhead trout.....	*20,000	..
	Landlocked salmon...	50,000	90
	Whitefish	1,000,000	90
1905—	Brook trout.....	300,000	94
	Lake trout.....	224,000	95
	Rainbow trout.....	100,000	48
	Landlocked salmon...	30,000	83
	Chinook salmon.....	†100,000	..
1906—	Brook trout.....	60,000	79
	Lake trout.....	80,000	94
	Rainbow trout.....	24,000	10
	Landlocked salmon...	20,000	93
	Chinook salmon.....	300,000	97
	Sockeye salmon.....	122,500	95
	Silver salmon.....	89,180	97

It will be noticed from the table that the eggs of the rainbow

§Planted eggs in Laguna la Grande en route to Nahuel Huapi.
*Hatched en route and planted from the vessel off the Brazilian coast.
†Eggs a total loss.

trout in 1904 were planted en route to the hatchery. This was due to the fact that they were in bad condition and it is very doubtful if any of them produced results in the waters where planted. In 1905 only 48 per cent. of the eggs hatched, and in 1906 only 10 per cent. The cause of this low percentage is not postively known but in all probability it was due to the fact that the eggs were taken from fish which were reared in spring water and the eggs were eyed in water of a temperature of about 53 degrees. They were then subjected to a temperature of 34 to 35 degrees for a long period—a necessary proceeding where they are to be carried in transportation cases on a trip from forty to fifty days in duration. Whether rainbow trout eggs taken from wild fish can be eyed successfully in an extremely low temperature and then transported with good results is yet to be determined by actual trial. Certainly it is known that rainbow trout eggs are more sensitive to temperature changes than any of the other species of Salmonidae artificially propagated.

The eggs of the steelhead trout which proved a failure in 1904 were undoubtedly too far advanced for shipment. The loss of the chinook salmon eggs in 1905 is not accounted for. They were packed by an expert who has successfully carried eggs of this species to New Zealand with very small losses, and the question of temperature or the stage at which packed are not factors to be considered unless the temperature of the eggs became too low while they were being held in cold storage in England or in Buenos Aires, in each of which places they were so held for several days. Eggs of other species shipped at the same time were held in a similar manner, however.

In addition to the eggs secured from the United States 25,000 Atlantic salmon eggs and 5,000 brown trout eggs were obtained in England during the past year. Hatcheries have been established at Nahuel Huapi, Santa Cruz, Alta Gracia, Buenos Aires and Chascomus. Eggs have already been taken from the brood stock of trout reared from the first lot of brook trout eggs sent to the country in the winter of 1903-04 and hatched and reared at Nahuel Huapi.

In addition to the acclimatization of foreign species of fish one native fish is propagated, namely, the pejerrey. There are two species of pejerrey in Argentina, *Basilichthys bonariensis* and

Basilichthys microlepidotus. They are regarded as the most valuable fresh-water fishes of the country. They are found in fresh, brackish, and salt water. During the winter months one species at least *(Basilichthys bonariensis)* ascends the Rio de la Plata from salt or brackish waters to places above Buenos Aires where it is caught by anglers with two or three hooks attached to one line, very much as the smelt is caught in the tidal rivers of New England However, there is never any ice in the Rio de la Plata. The fish is a spring spawner, ripe spawning specimens having been found from early October to late November according to the altitude or latitude and consequent temperature of the water in which caught. The fish has very clear white flesh and small specimens are almost transparent. When from five to eight inches long pejerreyes are served in English and American cafes in Buenos Aires as smelt.

I have seen adult specimens weighing five or six pounds but I understand they sometimes attain a weight of fifteen pounds. The fish has quite an extensive range in the country but the people are now stocking some of the uninhabited lakes with them, thus extending the range by artificial propagation. The eggs are adhesive and in some instances it has been found best to transport the eggs direct to the waters to be stocked and plant them in the lakes where they are surrounded by brush or other proper protection from predaceous birds and animals until they hatch. The eggs have also been hatched to a limited extent in McDonald jars.

There are no private fish cultural establishments in the country.

In addition to the work with fishes a practical oysterman has been employed by the government. He recently arrived in the country with a lot of oysters to be planted at suitable points along the coast. He is to remain in Argentina for an indefinite period and make investigations as to the possibilities for extending the work of oyster culture.

With each shipment of eggs from the United States to Argentina some minor improvements have been made. The following is a description of the case with improvements last adopted:

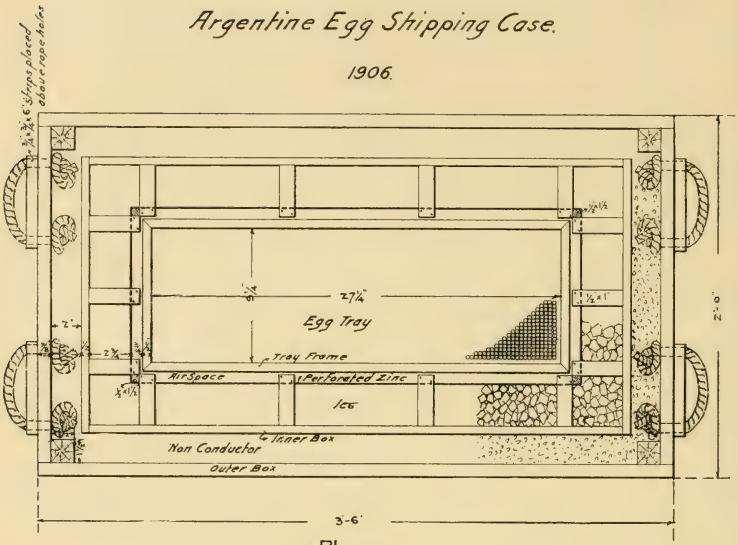
The case consists of an outer and an inner box, having a space between them filled with non-conducting material, an ice space,

Dept. of Commerce & Labor

Bureau of Fisheries

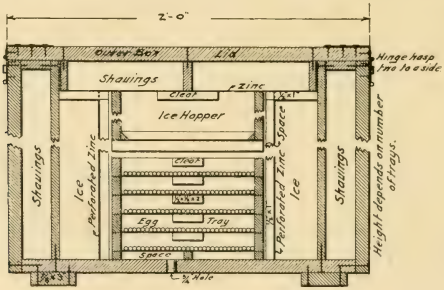
Argentine Egg Shipping Case.

1906.



Plan.

Scale.



Section.

and egg trays in the center, with a lid on top. The bottom of the outer and inner box is common to both. Tongued and grooved lumber should be used in the construction of the case.

The height of the case is based upon the number of trays required to carry the proposed shipment, though one or two empty trays are not objectionable. The case should be 3 feet, 6 inches long, 2 feet wide, and not to exceed 30 inches high, outside measure. Four hasps are used, two on each side of the lid, so that it can be opened from either side. Rope handles are placed on each end of each case, with a cleat of three-fourths inch material placed close above the holes for each rope handle.

Between the inner and outer box there is a two-inch space on all sides which is to be filled with a non-conducting substance such as shavings, moss or other suitable material, and covered as shown on blue-print. A similar space and non-conductor having a metal covering and fitting neatly over the ice hopper and space for ice should be attached to the lid of the outer box. It is important that the inner box be made water tight in order to keep the filling dry.

Between the inner box and the egg trays there should be a two and three-fourths inch space for ice, separated from the trays by perforated zinc, and between the perforated zinc and the trays a space of about three-fourths inch. The one-half by one inch and one-half by one and one-half inch vertical supports for the perforated zinc are to be placed between the perforated zinc and the trays. These supports are held in position by short strips of the same material fastened on top.

The ice hopper is made of thin material and covered on the bottom with perforated zinc. Cleats or small rope handles should be attached to the ice hopper which is made removable but so fitted as to secure it against sliding.

The tray frames are made of one-half by one and one-fourth inch lumber, and it is important that they fit easily in the center of the case. The bottom is to be covered with wire cloth of No. 25 or 27 wre, about twelve meshes to the inch, which is stretched tightly so that it will not sag, causing the drip water to settle in the middle of the trays to the detriment of the eggs near the edges. It is desirable to have a covering of strong cloth over the edges of the wire bottoms of each tray to prevent their sticking

to the mosquito netting of the tray underneath. A short one-half inch lifting cleat is fastened to the inside ends of each tray. Wedges are used to keep the trays in place. The bottom tray rests on three small cleats fastened to the bottom of the case length-wise as shown in blue-print, and having small "V"-shaped grooves cut into them for the passage of drip water to the drain hole.

One three-fourths inch drain hole, provided with a cork, should be made in the bottom of the case as shown in blue-print. Two seven-eights by three inch cleats are placed lengthwise under the bottom of case. The inner box, bottom of lid, hopper, trays, perforated zinc, and supports are asphalted.

It is important that the outside dimensions of all tray frames be uniform that the trays may be interchangeable.

The eggs selected for shipping should barely show the eye spots without the use of a glass, and should be picked over very carefully. In packing, spread a layer of moss as evenly as possible over the tray bottom to a depth of one-half inch and upon the moss place a layer of mosquito netting. This prevents the eggs from mixing with the moss and working through it to the tray bottom. The eggs are laid upon the mosquito netting one to two layers deep, spread to within one-half inch of the tray frame, and covered with another piece of netting. The remainder of the tray is then to be lightly filled with moss. The upper netting should be cut large enough to extend up to the outer edge of the tray all around, so that in examining the eggs it can be rolled back and returned without disturbing the eggs.

The cases of eggs are usually stored in one of the fruit rooms to which the attendant has access daily. It is customary to wet down the eggs with ice water daily and pick them over whenever necessary. The water should be of the same temperature as the eggs, thirty-four degrees to thirty-five degrees and is poured through the hopper. The ice compartments are kept full of ice by replenishing daily or as frequently as necessary. There are, as a matter of course, occasional days when the attendant cannot have access to the fruit room.

NEW ZEALAND.*

When the Britons first settled in New Zealand they found beautiful clear water streams fed from snow-clad mountains which contained very few and inferior fresh water fishes. Acclimation societies were formed and through them shipments of eggs of various species of Salmonidae were imported with varying success.

The brown trout was introduced in New Zealand about thirty years ago. The first shipment was from England to Tasmania and from eggs obtained at Tasmania the stock was obtained for New Zealand waters. Later shipments of brown trout eggs were sent direct from England to New Zealand. With the exception of the Auckland district, brown trout have been put into almost every stream in the south and as a result there is excellent brown trout fishing in almost every district. Within certain distances of the sea in all east coast rivers brown trout have become anadromous, going down to the sea after spawning and living there all summer, returning in the autumn. These fish are frequently taken by fishermen in nets when fishing for indigenous marine fishes. The fishermen say that they are caught in from five to seven fathoms of water. In handling them for stripping they have run from five to twenty-two pounds in weight. They are very much esteemed by the sportsmen. They take the fly readily but not more so than the steelhead trout; in the lower regions they are taken by casting the ordinary spinner. Brown trout are also found in lakes of the south. Records show the weight of the lake trout to be twenty-seven pounds.

Several importations of Loch Leven trout eggs direct from the hatchery of Sir James Gibson, Howieton, Scotland, have been made. The fish hatched from these eggs were held as brood stock in the ponds of the various acclimatization societies, and the young fish from the brood stock thus obtained were liberated in the streams—sometimes in the same rivers with brown trout. Commissioner Ayson states that where the Loch Leven trout has been introduced into the same stream with the brown trout it has been impossible to note any difference in the two species. A few Scotch sea trout have been introduced into New Zealand and

*The Committee is indebted to Mr. L. F. Ayson, Fish Commissioner of New Zealand, for most of the information following.

the opinion prevails that the sea trout, *S. trutta* is the sea run *S. fario.*

About twenty years ago the speckled trout, *S. fontinalis,* was introduced and nearly all of the acclimatization societies in New Zealand hold a brood stock of them in their ponds. In only two streams of New Zealand has this species obtained a foothold—one in Auckland district, about fifteen miles from Rotarori and one in the Canterbury district. Brook trout have been caught with rod and line up to six pounds in weight. The failure of this species to become firmly established throughout New Zealand is attributed to the presence of the brown trout.

About twenty-five years ago the Auckland Acclimatization Society was presented with a shipment of steelhead trout eggs from California by the late Thomas Russell. It is reported that this is the only shipment of eggs of the species which has ever been sent to New Zealand from the United States. The eggs were obtained from Mr. A. V. Lamotte, who had a private fish hatchery at Glenn Ellen, California, and were secured from steelhead trout taken in Sonoma Creek. They were shipped under the name of rainbow trout eggs and to this day the fish is called rainbow trout in New Zealand. The fish hatched from these eggs were liberated in streams flowing into Lakes Rotorua and Rotoiti, and other streams in the Waikato district. They have done remarkably well throughout the whole of the Aukland province, and lakes and streams in which brown trout existed previous to the introduction of the steelhead trout now have nothing in them but the latter. They seem to have superseded the brown trout. The Auckland district is the only part of New Zealand in which the steelhead trout have done remarkably well. The records show that steelhead trout have been taken up to twenty-five pounds in weight, and fish ranging from ten to eighteen pounds are not an uncommon occurrence. The larger fish are taken by trolling. The fish generally taken with the fly range from two to seven pounds in weight. Thus far there has been no evidence that the fish have become anadromous.

While the steelhead trout seem to have superseded the brown trout in the streams and lakes of the Waikato district, the many attempts to introduce them in the waters of the Wellington district seem to have resulted in failure, due to the presence of the

brown trout. Apparently the waters in which the steelhead trout survive the brown trout have a somewhat higher temperature than the waters in which the brown trout superseded the steelheads. The highest summer temperature in the snow-fed rivers in the south island is about fifty-five degrees. This is where the brown trout do not allow the steelheads to obtain a foothold.

No definite results have followed the attempts to introduce the chinook salmon previous to the year 1900. At this time the New Zealand government took up the introduction of this species in a systematic way and since then has devoted its efforts to one river, namely, the Waitaki. This river has its source in three tributary streams which flow into lakes and the outflow from these lakes form the Waitaki, which is a stream about the size of the Sacramento River in California. Chinook salmon eggs have been imported annually since 1900 and a good percentage of them have been successfully hatched. Some of the young fish have been held until over a year old before being planted. During the autums of 1904 and 1905 (month of April), reports came from the streams flowing into Lake Ohau that fish resembling salmon were spawning. The information was not received at headquarters until six weeks after the time the spawning was observed, and when a man sent out by the government to investigate had arrived, the fish had disappeared. Fishermen have stated that fish caught at the mouth of one of the tributary streams during the last two years are brown trout. However, two of these anglers, of large experience in fishing for salmon in Norway, are emphatic in their statements that they caught salmon.

There have been a great many importations of Atlantic salmon eggs, all obtained from England. The introduction of the Atlantic salmon was begun thirty years ago. In 1898 two specimens, twelve and sixteen pounds in weight, were caught by anglers and forwarded to Dr. Gunter of the British Museum, who on examination pronounced them to be *S. salar.* For the present, however, the attempts to acclimatize the Atlantic salmon have been discontinued.

Several shipments of whitefish eggs had been made to New Zealand previous to 1903 and upon arriving in the country there was no convenience for hatching them. They were divided up

into lots and turned over to the acclimatization societies, and it is presumed that very few if any fish were successfully planted. In 1903 the New Zealand government established two small whitefish stations on Lakes Kaneri and Tekapo, and shipments of whitefish eggs have been received annually, beginning in 1903, and a large percentage of them have been hatched and planted.

English perch have been introduced in some of the New Zealand streams where they have obtained a foothold and depleted the brown trout. They also follow up the spawning trout and devour their spawn. These perch when caught sometimes weigh four pounds. English tench have been introduced into shallow water lagoons not suitable for trout.

Great credit is due to the acclimatization societies for the work done by them, but it is unfortunate that the government did not assume control of the work in the start and conduct it systematically. The presence of the brown trout in the large portion of the waters of the country makes it impracticable to introduce some of the other finer, more desirable species. The acclimatization societies were originally founded from motives of public spirit but at the present time most of them are established on a commercial basis. They control the waters which they stock with fish and the anglers pay for the privilege of fishing in these waters. A whole season's license is $5 and a half season's $3. Visitors can take out a license for a day or two at the rate of 50 cents per day.

For a description of New Zealand waters and other particulars of interest to anglers reference is made to Hamilton's Trout Fishing and Sport in Maoriland.

TASMANIA.

The fisheries act of 1889 provides for the appointment of commissioners of fisheries, not exceeding twenty-five persons, in whom are vested the general superintendence, management and protection of all the fisheries in the State of Tasmania. Various species of the Salmonidae have been introduced, namely, *S. fario, S. trutta, S. fontinalis, S. levenensis, S. irideus,* chinook salmon *(Oncorhynchus tschawytscha),* and blueback salmon *(Oncorhynchus nerka);* two indigenous species—the fresh water herring or cucumber fish, *Prototroctes maraena,* and the fresh water black-

fish, *Gadopsis marmoratus*—have been propagated, and three of the family *Cyprinidae*—European carp *(Carassius vulgaris)*, goldfish *(C. auratus)* and English tench *(Tinca vulgaris)*, have become well established in Tasmanian waters.

Until recently the young fish were distributed as soon as the umbilical sac was absorbed and the fry began feeding, but lately it has been decided to distribute the fish as yearlings The commissioners have two hatcheries, one at Hobart and the other at Launceston The government makes no appropriation, the hatcheries being supported by receipts from the sale of licenses and the sale of fish ova to neighboring states. The hatchery near Hobart was established in 1864 and the one at Launceston within the past five years As funds are limited, very little money is spent in the artificial propagation of fish. During the year 1902, eggs to the number of about 600,000 blueback salmon, and about 300,000 rainbow trout, brown trout, Loch Leven trout, brook trout, and Scotch sea trout were hatched and distributed. During the year 1905 the output of the hatcheries consisted of about 300,000 rainbow, brown, Loch Leven, brook and Scotch sea trout. The general results from all of the above named exotic species with the exception of the blueback and chinook salmon have been successful. Brown trout have been captured by rod weighing up to twenty-nine pounds, and rainbow trout in some of the waters have attained in one year and ten months a weight of four and one-half pounds.

The sentiment of the general public has been on the whole favorable to the introduction of the Salmonidae, and from a tourist point of view it has attracted annually large numbers of anglers, not only from Australia, but also from England and India. There are no private fish hatcheries in the country.

ENGLAND.*

The government of England does not engage in fish culture, but the Board of Agriculture and Fisheries maintains an observant attitude toward the subject and exercises authority in respect to many matters, such as the enforcement of the fishery laws, the

*For the facts herein stated we are largely indebted to the Hon. Charles E. Freyer, Supervising Inspector of Fisheries, Board of Agriculture and Fisheries, London.

collection of statistics, the construction of fishways, termed "salmon ladders" and "fish passes," and the issuance of fishing licenses; and acts as the adviser of the government in fishery matters generally, both fresh water and marine.

There are, however, numerous private fish culutral establishments, including two devoted to marine fishes. Of parties engaged in fresh water fish culture we have a list of thirty-three. Of these, twenty-nine are found advertising in a few numbers of three English journals in 1906; twenty-eight of them state what classes of fish they breed or handle, and twenty-five specify the species. We find that amongst these advertisers, eighteen mention the European brown trout *(Salmo fario)*: thirteen the Loch Leven trout; twenty-one the rainbow trout *(Salmon irideus)*; three the American brook trout *(Salvelinus fontinalis)*; and one party the steelhead trout. Of fishes of other families there are four offers of perch, two of roach, and one of bream, and from other sources we are able to add to this list of coarse fish for sale, carp and tench.

Some of the establishments, we are informed by our correspondent, also handle the Atlantic salmon *(S. salar)* and the grayling *(Thymallus vulgaris)*. The Atlantic salmon would appear to be the special object of the work in the River Eden Salmon Hatchery at Carisle.

As stated above, the American brook trout *(S. fontinalis)* and the rainbow trout *(S. Irideus)* are among the species regularly propagated by many fish cultural establishments, but the prospect of their becoming acclimated is not regarded as favorable. The brook trout is reported as having almost entirely disappeared from the open waters where introduced, and the rainbow, though thriving well under certain conditions, is apt to disappear entirely from waters where it is not strictly enclosed.

The acclimatizaton of the steelhead *(Salmo Gairdneri)* has also been tried; and an attempt is now being made to introduce the Salmo Hucho from Austria.

In the marine hatcheries the species thus far propagated artificially are three species of flat-fishes, the sole *(Solea vulgaris)*; the flounder *(Pleuronectes flesus)*; and the plaice *(P. platessa)*; and among crustacea the European lobster *(Homarus vulgaris)*.

So far, then, as our information goes, it indicates a restriction to salmonoid culture more close, even, than is the case in America. Most of the advertisers offer fish one and two years old, many of them eggs; and there are many offers of live food materials and water plants.

It does not appear that the practice of growing any species of fish for market has yet established itself in England, and the use which seems to be anticipated by fish culturists of their products is the stocking of open waters for the purpose of angling, in which field Englishmen lead the world.

In angling, however, and in the use of the booty thus secured there is by no means the same limitation in species as we observe in the matter of artificial culture. The so-called "coarse" fishes (a term including all species except salmon and trout) are highly esteemed as objects of pursuit and material for food. Not only perch and pike, but the members of the Cyprinoid family, carp, tench, bream, roach, chub, etc., are thought proper objects for the exercise of the sportsman's skill. They are protected by the law, which provides an annual close-time, from March 15 to June 15, for all fresh water fish other than pollan, trout, char and eels; and the sporting journals overflow with notes of their capture, of which the successful anglers appear to be very proud. The conditions in English waters appear to be exceedingly favorable to the growth of fish and most species reach a larger size than is common with the corresponding species in America. The universal practice of weighing captures and reporting them affords a wealth of evidence in this matter. Among the numerous reports in the Fishing Gazette of London, we have lately observed, for instance, the recorded capture of chubs weighing from four pounds to seven pounds, fourteen ounces; tench weighing six pounds; bream of nine and one-half to eleven and one-half pounds; barbel of two and one-half or four and one-half pounds for small, and twelve or twelve and one-half for large; roach of three pounds, three ounces; carp of thirteen pounds, twelve ounces; and pike of thirty-six and one-half pounds.

The most important fresh water fishery of England and Wales is undoubtedly the salmon fishery There are about thirty rivers in which salmon are now caught. No complete statistics of the catch have been published, but reports from eighteen rivers

give a total of 61,474 salmon caught in 1904; and the total for the country is somewhere above that number. This is within the limits of a country having an area of 58,310 square miles, that is, about as extensive as the state of Michigan, and inhabited by 29,000,000 people. The sale of English and Welsh salmon at the great Billingsgate Market in London, which is believed to correspond roughly with the catch, declined in amount from 1895 to 1900, and after that rose in amount, the quantity passing through the market in 1904 being the greatest for ten years.

The decline which culminated in 1900 appeared so alarming as to call for investigation, and a royal commission was appointed for that purpose, having jurisdiction in Scotland as well as England and Wales After a very thorough inquiry that commission reported in 1902, and made recommendations embracing the enlargement of governmental authority over these fisheries, better regulation of fishing and more thorough enforcement of the laws governing the fishing, and measures to prevent pollution of the rivers, and obstructions to the ascent of salmon; and to secure a better maintenance of the volumes of rivers. With reference to artificial hatching they expressed the opinion that the case for it had not yet been sufficiently established to warrant their recommending the expenditure of public money on the establishment of hatcheries for supplying ova or young fish to the rivers of Great Britain generally, but that the subject was one of great importance and deserving much more careful study than it had yet received. They further advised the institution of systematic study, by observation and experiment, of the value of artificial hatching and of various problems connected with the life-history of salmon.

There exists in England an extraordinary number of fishery societies. A list, which may not be complete, shows fifty such organizations in active life in the early part of 1906. By far the greater part of them are associations of anglers, as the names indicate, and competitive and convivial purposes are prominent in their programmes, but some of them are organized for soberer purposes, such as the maintenance and enforcement of protective laws, the conduct of hatcheries, etc.

SCOTLAND.*

In Scotland the government is represented by the "Fishery Board for Scotland," which has about the same relation to Scottish fisheries as the Board of Agriculture and Fisheries has to the fisheries of England.

The board has established a hatchery for marine fishes at Aberdeen, where it also conducts sundry scientific investigations. The species bred are plaice, lemon sole, turbot, cod and some other kinds. Plaice is the leading species and 39,600,000 of these were hatched in 1904.

Fresh water species are not included in the work of the Fishery Board, but local boards and private parties engage in this work at some twenty stations. The most of them are salmon hatcheries, a few of them handling sea trout along with salmon; and two or three being commercial hatcheries dealing only with trout. At the fourteen salmon hatcheries operated in 1900 there were hatched about 3,565,000 eggs; at seventeen such establishments in 1904, the number of eggs handled was about 4,750,000 —of which probably 4,000,000 or a little more were hatched. The number of salmon fry reared in 1900 is stated at 185,000 for the whole of Scotland, and there is no evidence that more has been done in more recent years. It will be noted that for a country having eighty-one salmon rivers, the artificial work is on a small scale. It is indeed almost insignificant when compared with the vast numbers of eggs deposited by the salmon in the rivers in the natural way. In illustration may be cited the number spawning in the river Spey as observed by the bailiffs, whose duty it has been for many years, beginning in 1887, to count the number of spawning beds seen, the term "bed" being doubtless equivalent to "nest" and including only the deposit of one pair of fish. The number thus counted has ranged from 2,763 in 1890 to 7,658 in 1902, and must indicate the laying of twenty-five millions to seventy millions of eggs in a single year in that river.

There are no statistics showing the total product of the salmon fisheries of Scotland, but the Billingsgate Market in London receives great quantities of them, the receipts for the year 1904

*For data about Scotch fishery matters we are indebted to W. L. Colderwood, Esq., Inspector of Salmon Fisheries, Edinburgh.

being 14,753 boxes of one hundred pounds each, or upwards of 120,000 salmon. The great production indicated by these figures must be regarded as resulting almost wholly from the natural breeding of the salmon.

Among the trout-breeding establishments of Scotland is the famous one at Howietoun, near Stirling. Founded in 1873 by the late Sir James R. G. Maitland, it has been from the first, as now, the leading fish cultural establishment of Great Britain. It now offers for sale four species, the common European brown trout, the Loch Leven, the American brook trout and the rainbow trout, at these rates per thousand: for ova, $2.40 for brown trout and Loch Levens, $3.60 for American brook trout and $4.80 for rainbows; for yearlings prices ranging for the different species from $72 to $84. Two-year olds are to be had at $24 to $26.40 per hundred. These prices, which are doubtless about the same as those of other breeders, include transportation to any railway station in England, Wales or Scotland. The demand for these fish seems to be for the stocking of sporting waters.

The success of the introduction of the two American species is regarded by the best authorities as still uncertain.

NETHERLANDS.

Prof. P. P. C. Hoek, scientific adviser of the Dutch government in fishery matters, has communicated interesting information regarding the Rhine salmon and its cultivation and other fish cultural subjects.

The Dutch government engages in the artificial propagation of fish only indirectly and then only with reference to the salmon. Holland has only estuaries and a small part of the lower courses of the large rivers, whose sources are in other countries. There are no trouts, except a few rainbow and brown trouts reared in a private establishment and destined for restaurants in Amsterdam; there are no whitefish, except a migratory species *(Coregonus oxyrhynchus)*; there are no grayling. Of late the culture of carps and tenches has received the attention of some societies and private persons engaged in the fish trade.

With regard to salmon culture it may be noted that the Dutch government expends $3,600 to $4,800 annually in the purchase of salmon fry from hatcheries at the headwaters of the Rhine in

Germany, the release of the fry being superintended by an official representative. The fish are liberated in April when the yolk-sac is entirely absorbed, which is about six weeks after hatching. The number of such fry planted during the past six years was as follows:

1900	1,750,800
1901	1,959,200
1902	1,868,000
1903	1,532,500
1904	1,882,000
1905	2,417,500

These plants are in addition to large numbers hatched and released at the expense of Germany and Switzerland; in the former country this work has been carried on for at least thirty years.

Although only a comparatively short section of the Rhine is in Holland, the salmon fishery there is much more extensive than elsewhere. The run of salmon in the Rhine has greatly decreased in recent years, and all the countries concerned are very desirous of restoring the supply. Prof. Hoek states that it looks as if artificial propagation has done no good, but that nobody knows how bad the fishing would have become if no artificial measures had been instituted. The general public has no sentiment whatever in regard to the value of fish culture. The salmon fishermen are divided into two parties, the one thinking it is useless, the other thinking it would do good if practised on a much larger scale.

Prof. Hoek writes as follows regarding the habits of the Rhine salmon, which is of the same species as our Atlantic salmon:

You write: "The newly-hatched Atlantic salmon remain in the river for two years," and I found for the Rhine salmon that the majority remain in the river for one year only. They pass through Holland in the course of May. A part of them, however, remain longer; they are nearly all male fishes and are ripe in their second winter. What is very curious is that we never observed them wandering through Holland; I feel inclined to admit that these fishes do not grow old and have given up the seaward migration. But this is for the present an hypothesis only.

But a fact is that I have seen a great number of young salmon caught in May in Holland, and I am sure that they are fishes of thirteen to fourteen months only. I studied and described these fishes at some length and I would very much like to know how it has been ascertained that all the young Atlantic salmon remain in the American east coast rivers for two years"

SWEDEN.*

The Swedish government prosecutes fish cultural work through the Agricultural Societies, which receive subventions from the state for this work. At the head of these societies is the Royal Board of Agriculture. The Inspector of Fisheries is a member of the board and reports to it.

Artificial work is applied to the propagation of Atlantic salmon (Salmo salar); landlocked salmon; lake trout (Salmo trutta lacustris); sea trout (Salmo trutta); charr (Salmo salvelinus); whitefish (various species of Coregonus). The fish produced are mostly liberated as fry. There are in all forty-two hatcheries, of which the majority receive subventions from the state. In the year 1904 the agricultural societies paid out for fish culture 25,158 crowns ($6,793) and 600 crowns ($162) were expended on an establishment at Finspong, which belongs to the state and defrays its expenses in part by the sale of eggs and fry.

The total number of eggs handled in the different hatcheries in the year 1904 was as follows:

Atlantic salmon	2,117,000
Landlocked salmon	728,000
Trout (Salmo trutta)	535,000
Lake trout (S. trutta lacustris)	66,000
Charr (S. salvelinus)	719,000
Whitefish (Coregonus)	490,000
Total	4,655,000

Many instances of successful results are reported. Fish culture is in favor with the public, as is shown by the demand for fish planting.

*For this statement we are indebted to Dr. Oscar Nordqvist of Lund.

Of exotic species the American rainbow trout and the American brook trout have been introduced, the former having received greater attention; but results have not yet been reported.

In recent years a good many ponds have been constructed by private parties for the cultivation of carp and tench. For trout culture the principal private establishment is that at Engelsburg, belonging to a private society and devoted mainly to the cultivation of rainbow trout. Complete statistics of these matters are lacking.

In 1897 there was organized a Swedish Fisheries Society, located at Stockholm, where it publishes a journal appearing six times a year, the "Svensk Fiskeritidskrift." In 1906 another society, the Southern Swedish Fisheries Society, has been organized, chiefly for the purpose of founding and conducting an experimental station for fish culture and fisheries in ponds and lakes; for the breeding of fish races of rapid growth and adapted to the climate of southern Sweden; for the founding of a school for fresh water culture. The station is under construction at Aneboda, in the province of Smaland, embracing the fisheries school and about one hundred acres of artificial fish ponds; and besides these ponds the society has rented several small lakes for experiments.

FINLAND.*

In Finland the government engages in fish culture, and the duties connected with the work devolve upon an officer styled the Inspector of Fisheries.

The species artificially propagated are whitefish (Coregonus lavaretus and albula); brown trout, (Salmo fario) American rainbow trout (S. irideus); American brook trout (S. fontinalis); pike, (Esox lucius); roach, (Leuciscus rutilus); and charr, (Salmo salvelinus). The fishes hatched are liberated at various ages, but mostly as fry.

There are two public fish cultural stations, one at Evois and one at Helsingfors. The former is termed an experimental station, and the latter is connected with a Fisheries Museum.

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*To Dr. O. Nordqvist we are indebted for the facts about Finland.

From Evois there were distributed in 1905 the following fry:

Coregonus lavaretus	2,200,000
Salmo salar	23,000
S. fario	10,000
S. irideus	448
S. fontinalis	10,000
Esox lucius	10,000
Leuciscus rutilus	2,000

From the establishment at Helsingfors there are generally distributed some thousands of fry of the Ladoga charr, salmon and whitefish.

The planting of Coregonus albula and lavaretus and of the American rainbow trout have given practical results. The rainbow trout is found to thrive well in ponds and in one small lake, but the American bass, large and small mouthed, which have been introduced and planted in various lakes, have never been seen since their liberation.

Of private fish cultural establishments there are known to be three, of which two have been established within the past five years. They handle salmo ferio, Coregonus lavaretus and the American rainbow trout, but only for their private waters.

The Finland Fisheries Society, founded in 1891, publishes a journal "Fiskeritidskrift for Finland," arranges fishery exhibitions, sends out teachers on different fishery topics, etc.

JAPAN.

In addition to the account of fish-cultural and fishery matters in Japan which appeared in the Transactions of the Society for 1904, the Bureau of Fisheries has recently published a very able and instructive report by Prof. K. Mitsukuri, of the Imperial University of Tokyo, on "The Cultivation of Marine and Fresh Water Animals in Japan." It is therefore not incumbent on the committee to devote any special attention to Japan at this time.

Immediately on the conclusion of the peace treaty with Russia, the Japanese government took steps to exploit the valuable fishery resources of Saghalien Island and the Siberian littoral where fishing privileges were secured to the Japanese; and a

resulting very large increase in the value of the fishing industry of Japan may be looked for in a few years.

In 1902 the United States government forwarded to Japan at the request of the British Ambassador at Tokyo a lot of 25,000 brook trout eggs. There were hatched in Japan and the fry were placed in the river that flows from Yumoto to Lake Chuzenji, near Nikko, where they have become well established. Under date of January 22, 1906, Lieut. Colonel C. V. Hume, the British military attache at Tokyo, forwarded a splendid specimen in alcohol and wrote as follows regarding the only Asiatic colony of American *Salvelinus fontinalis*:

"These trout afforded very good sport during the months of May, June and July (1905), and a large number were taken, rather too many I am afraid. They were strong, well-shaped fish, in excellent condition and averaging about one-quarter pound in weight. One of the Japanese fishermen informed me that he had taken one of over a pound, but during the four days I was on the river in June I never saw one approaching that weight. The great bulk of the fish caught were taken by three Japanese fishermen who fished for the hotels at Chuzenji and Yumoto, and I have seen them with baskets of over thirty fish, all taken with rod and line. My best day was twenty. The fish take the fly readily and are not as shy as the brown trout of the British streams to which my trout fishing has hitherto been confined. They are sometimes slow to move and will not take till the fly has been presented to them three or four times. The most killing fly is a somewhat crude one dressed by the native fishermen. They also take, among other flies, the March Brown, the Blue Dun, and the Teal with yellow body. The Japanese fishermen also take them with a bright yellow natural fly and by dipping with a black water caterpillar, both found in the river. A fly-spoon is also useful for the deeper reaches."

CHINA.

Col. James L. Rodgers, a member of the Society and now American consul-general at Shanghai, China, reports that the Chinese government, through all of its multitudinous degrees or branches, does absolutely nothing, so far as he can learn, for fish culture or fish preservation. There are innumerable private

carp pounds and fish ponds in general, but apparently no scientific culture. Yet Chinese are great consumers of fish food and are to Col. Rodgers' mind the most expert fishermen in the world, not even excepting the Japanese; in the deep-sea fisheries, however, they do not appear to be as far advanced as might be expected in view of their proficiency in the lakes, rivers, and canals, where their devices are exceedingly ingenious and very efficient.

During the recent visit of the Imperial Chinese Commissioner to America, our fish cultural and fishery methods were made the subject of special inquiry, with a view to their introduction into China.

BOOK LISTS.*

FISH CULTURE.

E. Giesecke.—Culture pratique des étangs.—Goehmann, Hanovre.

A. Holztendorf.—Les eaux à poissons closes du royaume de Saxe.—Dresde.

E. Weber.—Guide pour l'exploitation des étangs.—Ulne, Stuttgart.

O. Zacharias—Comptes rendus des recherches de la station biologique de Ploen, 12mo volume.—Naegele, Stuttgart.

Rapport du laboratoire des pêches maritimes à l'Université de Liverpool et l'établissement de pisciculture marine de Piel. C. Tinling, Liverpool.

G. Billard et C. Bruyant.—Vitalité des Alevins de Truite dans les cultures d'algues.—Masson, Paris.

Borne, (von den).—Kurze Anleitung zur Fischzucht in Teichen.

Huebner, (A.).—Teichwirtschaft. (L'exploitation des etangs).—Emil Huebner, Bautzen.

Paresi.—Il Persico Sole nel Basso Ticino. (La Perche Soleil dans le bas Tessin). Brescia.

Vogel (P.).—Die moderne Schleienzucht. (La culture moderne de la Tanche). Emil Huebner, Bautzen.

D. Lugo.—Essai d'étude sur l'acquiculture au lac de Garde.—Miori Riva.

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*Books noticed in Bulletin de la Soc. Centr. de France, 1905, 1906 to May inclusive.

Ministere de l'Agriculture du Commerce et de l'Industrie.—L'action du ministère en faveur de la pêche et de la pisciculture en 1904.—Bertero, Rome.

J. Heuscher.—Guide pour l'élevage des jeunes Truites.—Attinger, Neuchatel.

Weeger.—L'élevage de la Truite et des autres Salmonides (4e edition, revue par C. von Gerl). Vienne, Hitschmann.

Bénardeau.—Pêche et reproduction du Saumon en Loire.—Paris et Nancy, Berger-Levrault.

Levi-Moreno.—Les travaux de l'Ecole de Pêche et d'Aquiculture de Venise pendant sa deuxième année d'existence.—Venise.

Cornello.—Rapport sur l'action morale de l'Ecole de Pêche et d'Aquiculture de Venise pendant sa deuxième année.

Borne (von dem).—Pisciculture artificielle revue par von Debschitz, 5e Edition, Parey, Berlin.

Susta.—La nourriture de la Carpe et des autres Poissons d'etangs, 2e Edit. Henke et Lebeling, Stettin.

Walter.—L'exploitation des petits étangs. Nouv. edit. Neumann, Neudamm.

Lavauden.—Recherches sur la biologiie, l'élevage et l'acclimation, dans les eaux francaises, du Poissons-Chat.—Allier, Grenoble.

Fabre-Domergue et Bietrix.—Development de la Sole. Introduction à l'étude de la pisciculture marine.

Fabre-Domergue et Bietrix.—Developpement de la Sole.—Vuibert et Nony, Paris.

FISHING AND FISH IN GENERAL.

G. Ferner.—La pêche à la ligne.—Grethlein, Leipzig.

Travaux de la Station de recherches relatives à la Pêche maritime à Ostende. Fascicule II. Ostende, G. Pots.

Martin, (J. W.).—La pêche du Gardon et du Rotengle.—Bourdon et Benoit, Paris.

Aarbog for den danske Fiskerflaade. (Annuaire de la flotte danoise de pêche). Copenhague.

H. Bourdeaux, G. Griolet et C. Verge.—Code forestier, suivi des lois sur la pêche et la chasse, et code rural avec annotations et renvois aux ouvrages de M. M. Dalloz.—Tours.

P. Buffault.—Essai sur les eaux et la pêche fluviale dans le departement de l'Aveyron.

E. Lebel.—De la nécessité qu'il y a de rendre l'épandage obligatoire pour les fabriques de sucre et pour les distilleries.—Doal, Péronne.

F. Rousselot.—Histoire de pêche.—Messeiller, Neuchatel.

Jho.-Pale.—La pêche en rivière.—Paris, Bellenand.

Le Bail.—La pêche, l'enseignment et le crédit maritimes.—Quimper, Guillaume.

Martin.—Code nouveau de la pêche fluviale, annoté et expliqué, 13e edition.—Paris, Lenormand.

Parker: La mutualité chez les inscrits maritimes.—Paris, Challamel.

Petit.—Code de la pêche.—Chalons, Martin.

Gunther.—Statistiques de la pêche dans les eaux continentales pour l'Autriche et quelques autres pays d'Europe. Hoelder, Vienne.

Victorin.—Les produits de la mer. Hartleben, Vienne.

Commission permanente pour l'etude des mers.—La peche dans la Baltique a l'epoque actuelle.

NATURAL HISTORY.

O. von Aufsess.—Les propriétés physiques des lacs. Vieweg, Brunswick.

G. Billard et C. Bruyant.—Sur le rôle des algues dans l'épuration des eaux.—Masson, Paris.

G. Antipa.—Les Esturgeons et leurs migrations dans les eaux continentals d'Europe étude particulière des espèces du Danube et de la mer Noire. Bucharest.

Zschokke.—Le Saumon et ses migrations. Stuttgart, Naegele.

Dr. F. K. Knauer.—Die Tierwelt unserer Suesswasser.—Aquarien.

Zacharias.—Sur l'importance des stations biologiques d'eau douce. Ploen.

Uerkull.—Guide pour les recherches de biologie expérimentale sur les animaux d'eau douce. Bergman, Wiesbaden.

Gautron.—La verité sur le grand Serpent de mer.—Giviend, Rouen.

Margerie (de).—La carte bathymètrique des oceans et l'oeuvre de la commission de Wiesbaden.—Colin, Paris.

TECHNOLOGICAL.

S. E. Meek.—The fresh water fishes of Mexico north of the isthmus of Tehuantepec. Field Columbian Museum, Chicago.

The Cambridge Natural History. Vol. VII. Une nouvelle introduction à l'étude de Poissons. Macmillan, London and New York.

E. Von Leyden.—La théorie parasitaire et l'étiologie des écrevisses. Hirschwald, Berlin.

R. Robert.—Les poissons vénéneux et les poisons du poissons. —Enke, Stuttgart.

A. Fedderson.—Agnbogen (Amorces).—Dansk Fiskeri-forenings Kontor, Copenhague.

Voeltzow et Lentz.—Décapodes et Stomatopodes de l'Ouest Africain.—Francfort-sur-le-Mein. Diesterweg.

D. S. Jordon.—A Guide to the Study of Fisheries.—Holt & Co., New York.

PERIODICALS.

Jahrbuch fuer Acquarien und Terrarienfreunde.—Hans Schultze, Dresde.

Bulletin Suisse de Pêche et de Fisciculture. Redacteurs: Savoie-Petitpierre et Prof. Dr. O. Fuhrman, Neuchatel.

Le Pêcheur. Organe des pêcheurs à la ligne et de leur societés.—Ph. Linet, Paris.

Pêche et Pisciculture. Organe de la Societé centrale pour la protection de la Pêche fluviale.

Dansk Fiskeritidende. Medlemsblad for Dansk-Fiskeriforening. Redaktor.

L'Acquicoltura Lombarda.—Bollatino mensile della Societa Lombarda per la Pesca e l'Aquicoltura.

Allgemeine Fisherei Zeitung.—Organ des Deutschen Fischerei Vereins, U. S. W. und der Kgl. Bayer. Versuchstation fuer Fischerei.

Revue des Eaux et Forêts, Paris, 13, rue des St. Peres.

Archives d'hydrobiologie et d'Etudes du plancton.—E. Nagele, Stuttgart.

Annuaire de la flotte danoise de pêche pour 1906.—Christren, Copenhagen.

Station de Pisiculture et d'Hydrobiologie de l'Université de Toulouse. Bulletin pour l'anné 1904.—Privat, Toulouse.

Rapports sur les pêches maritimes neerlandaises.—Van Cleff, S'Gravesande.

Near the conclusion of the report Mr. Atkins made the following comments:

In examining the advertising pages of some European journals, especially the German journals, I found large numbers of hatcheries offering eggs and young fish for sale, and I could hardly find one that did not offer either rainbow trout or American brook trout, and the majority of them were offering both. In fact, I think there were more of those advertisements that specified the American fishes than of those that specified the European brook trout. So that at present our American species are great favorites abroad. Some parties in England doubt whether the rainbow trout will be entirely successful, and I suppose for years it will be a matter of uncertainty.

The following discussion was had regarding the Paris hatchery:

Mr. Clark: Mr. Titcomb suggested that questions regarding the raceway might now be considered and noted in the proceedings. I would therefore suggest that the matter be taken up now. Mr. Marks is here, and is, I believe, ready to answer any questions.

Mr. Titcomb: I thought it would be a good thing to get answers to the questions a good many individuals have asked, and I hope the other fish culturists will also ask any that I may omit, so that we may get that matter in the report. I would like first to have Mr. Goodwin put down the recipe for the making of the Lane's food.

Mr. J. P. Marks: Two quarts animal meal with one and one-half pounds of salt put in water and brought to a boil. Then add

a mixture of eight quarts of corn meal and sixteen quarts of wheat middlings. Then cook about five minutes. This material is then put through a plate having perforations, for old yearling trout, three-sixteenths of an inch in diameter; for two year old trout, one quarter of an inch in diameter; and for the larger fish, of five-sixteenths of an inch in diameter; in order to produce the vermicelli-like substance which you have seen. While cooking, the material should be thoroughly stirred. The foregoing is a recipe for Lane's food.

Mr. Titcomb: How often is this food given to the fish and to what extent?

Mr. Marks: We feed it once a week and liver once a week to large fish.

Mr. Titcomb: Do you only feed your fish once a week?

Mr. Marks: Twice a week—that is, large fish—yearlings once a day, and two and three year olds, three times a week.

Mr. Titcomb: The Lane's food?

Mr. Marks: No. We feed the Lane's food once a week to all the fish, except fry and fingerlings.

Mr. Titcomb: Then after the spawning season the larger fish are fed three times a week with this food?

Mr. Marks: Usually right after the spawning season we only feed liver—this food is only given through the summer season—spring and summer.

Mr. Titcomb: And when you feed this food you feed this and the liver alternately once a week?

Mr. Marks: Yes.

Mr. Titcomb: What is the address of the company that makes this food?

Mr. Marks: The Bowker Company, 43 Chatham street, Boston; and 68 Broad street, New York.

Mr. Titcomb: I understand this food is especially useful at stations where you cannot have fresh meat always available, and

can be used as a standby to take care of fish for a week or two in such cases.

Mr. Marks: Yes. Three years ago we fed one or two pound rainbows nothing else than that for three months.

Mr. F. R. Bassett: What do you know regarding the quality of fish when prepared for the table with this animal food compared with liver fed fish wholly?

Mr. Marks: I could not say. Some of these men that use mixtures claim that the fish is improved by them. I do not think there is any doubt but what the mixtures of wheat middlings with any meat food improves the fish.

Mr. Bassett: Would you consider it as fattening as meat?

Mr. Marks: No, I don't think so.

Mr. Titcomb: It keeps your fish in better condition for spawning to have some of this food given them.

Mr. Marks: Yes.

Mr. Clark: I would lke to ask regarding the race, if you don't think that better results would be obtained and double the quantity of fry carried, if you had two sections, each half the length of the present raceway, and having the same flow of water? In other words, double the quantity of water and double your fish by having them in two shorter raceways?

Mr. Marks: Yes, I think better results would be obtained by the method you suggest.

Mr. Titcomb: You would double the capacity of your raceway for the same length?

Mr. Marks: Yes sir. We find a loss at the lower end larger than at the upper end, if the race were shorter with the same volume of water, the lower fish ought to be better.

Mr. Clark: The idea that I have, Mr. President, is that the long trough does not carry fish enough.

Mr. Titcomb: Would you shorten up your intermediate riffle compartment also?

Mr. Clark: No, nothing to amount to anything.

Mr. Brown: You put more fish in each division?

Mr. Clark: More fish would naturally come in each division, and the idea of having the two race ways of 200 feet each is that you could introduce double the quantity of water for the hundred thousand fish, whereas it would not be safe here now, even if there was an ample supply, to introduce it when the fish were young, because the current would be too strong.

Mr. Marks: With the amount of fish we have there now, by fall it will be crowded—the growth of the fish will crowd it.

Mr. Titcomb: With the current which you have, do your fish dash against the screen?

Mr. Marks: This sized fish?

Mr. Titcomb: Yes.

Mr. Marks: No, but putting fry in from the trays it will drive them against the screens.

Mr. Atkins: What proportion of those fish do you expect to die during the season?

Mr. Marks: I do not think we will lose over three or four per cent.

Mr. Atkins: Between now and when?

Mr. Marks: Say between now and September—provided there is no disease.

Mr. Atkins: How do you take out the dead ones?

Mr. Marks: With a scap. When we clean it down the dead ones wash down against the screen and are taken off.

Mr. Atkins: Do you count or keep a record of the dead ones?

Mr. Marks: No, sir.

Mr. Atkins: But you satisfy yourself of the amount of fish after you get through.

Mr. Marks: If we get many dead ones we know there is something wrong.

Mr. Lydell: How do you get your fish out of there finally?

A. It is not very hard.

Q. How is it done?

A. With a small seine.

Mr. Titcomb: Do you take them right up in the seine?

Mr. Marks: Yes, sir.

Mr. Titcomb: I think it would be easy to put below each riffle a flat frame of fine netting, so that they would wash down on it, on the principle of down-stream salmon rack.

Mr. Marks: We take the bulk out with a seine and then take two screens and a scap, and catch the rest, and then move on down and do the same thing. There is no trouble in catching them.

Mr. Atkins: You count those fish that you put in there?

Mr. Marks: Just estimate them—that is all.

Mr. Atkins: And when they are taken out in the fall do you estimate them again?

Mr. Marks: We will count them—at least we did last year, but we don't always count them.

Mr. Lydell: How many fish did you get out of there last year in full?

Mr. Marks: I could not say—I think we had 17,000 brook trout and about 25,000 rainbow.

QUESTIONS FOR THE QUESTION BOX, AMERICAN FISHERIES SOCIETY.

BY JOHN L. LEARY, SUPT., SAN MARCOS STATION, BUREAU OF FISHERIES.

1. Can anyone tell how to distinguish the sex of black bass, with certainty other than by eviscerating?

2. Have artifical nests, after thorough trial, proved satisfactory?

3. Have you ever transferred black bass fry, just after they rise from the nest, to nursery ponds and held until two to four inches long, and with what results?

4. Have you ever stocked up an applicant's pond with black bass fry just after the food-sac has been absorbed, and watched the results?

5. Which do you think gives best results planted in small streams, lakes and ponds, fry or fish?

6. In pond culture have you found it best to impound your fish in small areas, or allow them to nest at will?

7. Do you approve of feeding your brood fish between the seasons of spawning?

8. Do you in your pond work, find it necessary to clean your ponds every season after getting rid of your young fish?

9. Do you find much trouble in handling crappie (the young for distribution) in very warm weather?

NOTE: What I mean by fry is from the time the embryo leaves the egg to the time the food-sac is absorbed, and fish, from the time they are one or more inches long.

DISCUSSION.

Secretary: I would like to say that a conversation I had this morning with Mr. Seymour Bower related to one of these questions and therefore I think it would be important to those who are raising bass, to have some of these questions answered, if not all. The question I refer to was this:

"In pond culture have you found it best to impound your

fish in small areas, or allow them to nest at will?" This is question number 6.

President: We will take up question number 1. "Can anyone tell how to distinguish the sex of black bass with certainty otherwise than by eviscerating?"

Mr. Titcomb: That is answered in Mr. Reighard's paper.

Dr. Birge: It seems to me that most of those questions are pretty well answered in that paper.

Mr. Titcomb: I think that question about impounding the adult fish might be a good one to answer here and have it put into the report. Mr. Leary is talking especially about the large mouth bass, and as far as I know the segregating of the parent fish from the main pond is being discontinued.

Mr. Lydell: We now allow our large mouth bass at the Mill Creek Station, to seek their own spawning nest. We are certain to have plenty of natural spawning ground for them though, but we build no nests for the large mouth bass.

Mr. Titcomb: At the Fish Lake Station, in Washington, we supply the large mouth bass with small piles of gravel scattered around, and they sometimes select them and sometimes they take the weeds. This is a station where the impounding idea was carried on most extensively, and as the apparatus which separates the adult fish from the principal part of the pond rots out, we remove it as not being at all necessary. The cannibalism does not come from the large fish.

Secretary Peabody: Mr. Bower stated to me this morning that he thought the transferring, molesting or changing of the black bass was injurious, but I presume he was referring rather to the small mouth than the large mouth bass perhaps.

Mr. Titcomb: We have ponds like those at Mill Creek; separated by a partition, lattice-work, or net-work, a small portion—one corner. We let the adults spawn in that corner and then the young fish are supposed to have sense enough to go out through these slats into the main pond and separate themselves from the large fish. That method was adopted because I think at the

time the fish culturists thought that the large fish were the ones that ate these small fish, but instead of that the small fish really ate each other. Now we take away those enclosures as fast as they rot out because they are of no advantage.

Mr. Fullerton: You let the parent fish and the small fish go right together?

Mr. Titcomb: Yes—that is for the large mouth bass.

Secretary Peabody: Question number 7 is: "Do you approve of feeding your brood fish between the seasons of spawning?"

Mr. Clark: Certainly.

Secretary Peabody: Question number 8 is: "Do you in your pond work find it necessary to clean your ponds every season after getting rid of your young fish?"

Mr. Lydell: I clean mine if necessary, and if not, I do not. I think a man should use his own judgment in regard to that. If his ponds need cleaning let him cleam them.

Mr. Clark: That has reference either to cleaning out refuse or cleaning it from the last fish. If from the latter, most certainly; and draw them dry if you can.

Secretary Peabody: Question 3 is: "Have you ever transferred black bass fry, just after they rise from the nest, to nursery ponds, and held until two to four inches long, and with what results?"

Mr. Clark: I answered that question at our meeting either yesterday or the day before, when I stated that I had transferred 10,000 fish to a pond, and we counted out 8,325 number two fingerling fish from that number.

Mr. Titcomb: That is the small mouth bass?

Mr. Clark: Yes.

Mr. Lydell: But he speaks of large mouth—there is great difference between transferring large mouth and small mouth bass—there is more loss in the former.

Mr. Fullerton: Do you think that the draining of the ponds after taking the fry out and putting the adult fish in another

pond, would be good policy—that is in a climate like Minnesota, letting the pond remain dry all winter?

Mr. Clark: I am not prepared to state.

Prof. Reighard: It is the practice to do that with the German carp ponds. Exposing the vegetation and the soil in the bottom of the pond to the air helps decay, and the freezing loosens up the soil more or less, so that altogether the method has a tendency to break down the more complicated chemical compounds in the plant material, and make them more available for plant growth the next year. I think Mr. Lydell has had a little experience in that line.

Mr. Lydell: Our ponds were dry from about the first of September until the latter part of November, and our plant life in there did not come on quite as early this season as it has in former years but it is just as abundant now as it is in the other ponds.

While I am talking I would like to ask Dr. Birge or Prof. Reighard in regard to the introduction of foods in our ponds. I noticed that the ponds that were dry the longest last fall were the ponds that produced the most food this spring for fry and young fish, and I was greatly surprised because I supposed that the frost would kill everything, and did not expect anything at all from the ponds whereas I got the most food from them. If it is beneficial I will draw all my ponds dry this fall and leave them dry all winter if it will bring me more food. If it is beneficial to leave them dry during the winter to get daphnia and this food I should like to know it.

Dr. Birge: That is one of the things you have got to try a good many experiments on before you know what is best. But I should say that the exposure of the bottom of the pond to the air, and perhaps to freezing, loosened up the material and put it into a more soluble form, so that when the water came back on it along in the spring there was more rapid growth of the minute organisms on which these feed, and so they had a better chance to develop. It does not seem to me at all unnatural that that should be the case, but I think you want a good many comparisons. This

result is what these carp raisers find in Germany, and I should think the same principle would hold here.

Mr. Clark: Are we to understand that the plant life would grow more abundantly if the ponds were drained as suggested?

Prof. Reighard: That is true of the microscopic life but not of the chara.

Mr. Clark: I was in hopes to have a photograph here to show how abundant the moss is at Northville. Mr. Titcomb asked me to have a picture made of a pond drawn down, showing the moss heaped up preparatory to removal. However, the photograph has not, as yet, been forwarded here.

Dr. Birge: I would not expect drawing a pond down would check chara, but I would not be certain of it.

Mr. Titcomb: Mr. Fullerton raised the question of removing bass from large ponds and placing them in small ponds during the winter. That has been the plan adopted in Washington, and we have experienced no trouble in confining the adult fish in small ponds through the winter, and have kept our large ponds dry, thinking it was better for them for the reason Dr. Reighard has stated, and in hopes that there was less luxuriant growth of plant life as a result. We have a superabundance of aquatic plants—and it is to eradicate them.

Prof. Reighard: When the daphnia and other crustacea begin to grow in the ponds they increase very rapidly for a certain time and then they diminish. It is possible that by using the ponds in a certain rotation one might keep up the supply of crustacea for a much longer time than by flooding them all at one time. The water might be turned into a pond, and when the food has appeared there, might be used for the fry and subsequently the water might be turned into another pond and so on.

THE CARE AND FEEDING OF FRY IN POND LIFE.

SENT IN BY F. M. JOHNSON, M. D., BOSTON.

Mr. President and Gentlemen: A salient point for first consideration is the preparation of the ponds. There should be many places where the water is shallow and its force is slow, other nooks where there is abundant shade, again where the waters deepen, especially where the current is marked large boulders should be thrown, providing resting places and safe hiding corners for the tiny forms of life, we are all so interested in. As all good ponds should be fed by a brook, its course ought to receive special attention. Many fairly deep pools can be artificially made by the careful adjustment of stones, and of small dams.

If we follow out the natural lines it is an easy task to enhance their natural inclinations. If the stream admits of a bridge, one or more, then place them where they will be of value.

It is my pleasure to see each summer that my brooks are as perfect as I can make them, all old rubbish that alone blocks the stream should be removed, a clean white sand at the bottom of the brook is the thing to be desired. When the pond is reached, it is a wise procedure to clean it of all old and odd stuff that may have been thrown into it. Then to control the current of the brook so it will take the desired direction.

The growth of bull-rushes and water grasses should be encouraged and aided, for among the shielding leaves, shade and protection are given. Old stumps of trees should be allowed to remain where they are, all smaller streams that empty into the pond might be aided by removing all clogging to the minute streams that add food and oxygen to the pond waters. The white lilies I favor if they are not allowed to multiply too rapidly. The dams should be perfect in construction and the wire netting kept clean.

Let us now suppose that these details have been carried out and the fry is ready for the new home. How and where should they be placed? Never in my opinion ought they to be poured

from the can in any one especial place. No matter how tempting this particular locality appears. Always a few should be dipped from the can and distributed along the shores of the pond and in the places by the brookside prepared for them. They now soon learn to care for themselves. When the fry is very small no attempt should be made to feed them for there ought to be a good and sufficient supply in the waters of the brook and pond. A little later small schools of fry will be discovered at different localized areas, and then feeding can be begun. If angle worms are chopped up into small pieces, they make the very best food possible and a natural one.

Of course this would be impossible where there might be many ponds or one pond that covered too much territory, but in a medium sized pond, it is not at all difficult. The luscious denizen of the world below the grasses may not be easy to obtain and the next food that has marked value is buttermilk. With this all that is necessary is to pour a little of it in the water where the fish are seen and they do the rest, or the finely ground up liver can be used. With liver perfect freshness is absolutely necessary for the slightest taint and the delicate children die of intestinal disturbances. As the fry gain in size and strength, they begin to be fingerlings and better able to take the foods mentioned when not in quite such a finely mashed up condition.

Well cooked vermicelli is now greedily snapped up and if not given too often is most excellent. Ordinary cheese in very small pieces never reaches the bottom and is swallowed most readily. A piece of meat suspended over the stream will in a short time give a good supply of maggots and these seem to be devoured quickly. Food of any kind should be thrown in small quantities so it can be seized and not fall to the bottom. Salt ought to be added to the foods now and then. Ordinary milk curd made with milk and Fairchild's pepsin, and squeezed out through a piece of gauze, is another food, easily digested by the fry, and readily prepared. The yolk of hard-boiled eggs, mixed with a little salt and strained through a fine meshed seive, makes a change in djet that is appreciated. Once a week at least, if the waters are not stirred up by the rain, they should be stirred up by wading about in them, so that for several hours, they become markedly muddy. Into the waters salt should be thrown once

in ten days or a fortnight. By these measures, I feel sure I have raised fry and very small fingerlings, that looked when I received them as being in bad condition, sickly and with fins frayed, to beautful fish who survived the winters of cold, and are today as perfect specimens as could be desired. To these few conclusions and applicable alone to the small ponds I would, gentlemen, call your attention.

1. Fry should never be distributed en masse, but always a few at a time and the localities chosen.

2. Cut up worms, buttermilk, maggots, milk curd, cheese, hard boiled eggs, vermicelli, and finely minced liver are all good foods.

3. The preparation of the pond and brook is a prime necessity.

4. Fry are apt to be handled too carelessly. They are extremely delicate, and should receive extreme attention.

I thank you, gentlemen, for your courtesy.

THE FISHWAY AT GRAND LAKE STREAM.

SENT IN BY W. O. BUCK.

This is in some respects a new departure.

It is here definitely described partly for this reason and also for the purpose of directing attention to conditions which may well exist elsewhere and which should be carefully considered by fish culturists and met in some way wherever found. Let these be stated first.

THE LOCALITY.

Grand Lake Stream is the outlet of a large lake at the head of the west branch of the St. Croix River in eastern Maine. This lake is well stocked with a small variety of landlocked salmon. It has been asserted that all the adult salmon in the lake come to this stream to spawn, and conclusive proof to the contrary is yet wanting. The stream is a rapid one and for two miles below the dam contains many gravel beds suitable for ridds. Above the dam and within one hundred yards of it is a gravel bed which suits the fish when the water is low enough in the lake and the gates in the dam are opened enough to give sufficient current. The management of the dam for many years has met these conditions and the fishing for spawning purposes has been carried on by placing a barrier net across the river just above this gravel and then setting a trap for fish trying to reach it from the lake. If such a barrier could be maintained throughout the year and fish thus be kept from passing down through the dam, all spawners coming to the stream from the lake could be captured at the spawning season. But this barrier is maintained only from September 15 until a short time after spawning is over, about December 1. While the fish doubtless seek the stream in greater numbers at this season, they will also run down over the dam at other times.

THE DAM.

The dam has for long been in such a condition that fish could pass it only downward and could not safely do that except in a

comparatively high stage of water. The leaky aprons wasted water so fast that they became a trap for fish somewhat after the manner of an Indian eel-basket. Fish allowing themselves to float down through the gate were likely to be caught in cracks or stranded on the plank. As little or no water flowed over the lower end of the aprons which were close to or above the surface of the stream, no fish could pass up.

As now rebuilt, however, the dam is twelve feet high and maintained for storage of water to be used in driving logs through the stream and also as a reserve for supplying water for power to mills lower down the St. Croix. The gates are therefore closed during a considerable part of the year and the stream then becomes a small brook with most of its spawning gravels laid bare. During the driving season, on the contrary, the gates are opened and the stream is a river, broad, deep and swift, while the logs are being sent through, to become a brook again when for any reason the gates are closed. In case of a jam of logs and sometimes for other reasons the gates are all closed suddenly and fish are then very liable to be stranded in little pools where they must die as the water drains away. In fall, when water is needed for the mills, the gates are opened and fish on the stream to spawn find just the conditions they want on the gravels. Later in the winter the gates are closed to let the lake fill, the gravels are again laid bare and eggs deposited there are of course destroyed. As thus managed the stream is evidently a poor place for fish, young or old, and the problem is either to modify the management or get the fish off the stream. Each gate in the dam as now built is in too sections; a top part to be lifted when the water is high and a bottom part three and a half feet high, which may also be raised at a lower stage of water. During the high water this three and a half fall over the lower part of the gate upon an apron forms a complete barrier to fish passing up but none, of course, to their going down. And this period of high water will be from early spring until fall. Perhaps it may prove unnecessary to raise the lower sections of the gates at all, in which case the barrier is permanent. To be sure of getting the salmon up over the dam then, they must be carried or a fishway must be provided through which they can swim up. An effort was made the past fall (1905) to trap and net fish on the stream and carry

them above the dam and more than 1,000 were so carried up. This, however, was discontinued at the end of the spawning work of the station. To help fish left on the stream, or which might reach it later, the present fishway was devised. This was intended to help them in two ways. First, by providing a passage through which they might go to the lake if they chose and secondly, by securing a constant, even if small, stream in which they might live though all the gates in the dam should be closed. To provide such a stream is necessary because some fish, even if only the very young, will elect to stay in the stream. The fishway as built consists of a straight flume about seven feet wide and fifty feet long, divided into eighteen pools by partitions reaching from side to side and from top to bottom. In these partitions openings eight inches high and two feet long are made at a height of ten inches above the bottom. At the lower end the opening is at the bottom and also at the upper end, and, since the bottom of the flume is nearly level in its upper part, severed of the upper openings are nearer to the bottom than ten inches. This arrangement at the upper end is necessary because at low water in the lake only a few inches in depth enters the fishway and all openings in the partitions must be low enough to allow this to pass. It is for this reason too that the openings are raised above the bottom in the steeper part of the fishway and are placed on alternate sides of the flume, since, when so little water enters, the pools are not filled and the fishway becomes of the former shallow pool sort.

Four of the pools are above the line of the gates in the dam, i. e., extend up into the lake and their sides, of course, reach to the whole height of the dam. Just below the gate the sides of the flume are some two feet lower than above and thence slope down to the level of a full stream at the lower end. As thus built the pools fill to such a height that the total fall from lake to stream is divided into as many steps as there are partitions. The force of water at any opening is therefore not too great for fish to swin against and the water in all the pools is unbroken and of sufficient depth to provide resting places for fish while in them. Such resting places they will find either at the side or above or below the openings, since eddies or nearly still water are to be found at all such points. Apparently fish will find no

difficulty in passing either up or down through this fishway at any stage of water. And again the volume which will pass an opening eight inches high and two feet wide, even under a small head is sufficient to enable fish to find it and as the outlet of the fishway is at the bottom and only twelve feet down stream from the end of the apron of the dam it is easily accessible. In conclusion, however, be it said that the fish have not yet expressed themselves as to the acceptability of the fishway and theirs is the decisive vote. When they come to the dam this fall it is hoped to learn their view of the question. Meanwhile the fishway is open for consideration and incidentally for passage of a considerable amount of water to supply the stream below when other sources are scanty.

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Slade, George P., *309 Broadway, P. O. Box 283, New York City.*
Smith, Frank W., *Superintendent Coos River Hatchery, Marshfield, Ore.*
Smith, H. G., *Minneapolis, Minn.*

Smith, C. Jay, *care of J. W. Marston & Co., Lewis Wharf, Boston, Mass.*

Smith, Lewis H., *Algoma, Ia.*

Smith, Dr. Hugh M., *United States Bureau of Fisheries, Washington, D. C.*

Smith, J. A., *13 West 25th Street, Baltimore, Md.*

Snyder, J. P., *U. S. Bureau of Fisheries, Washington, D. C.*

Southwick, J. M. K., *Newport, R. I.*

Spencer, L. B., *Superintendent Aquarium, 37 West 128th Street, New York City.*

Spensley, Calvert, *Mineral Point, Wis.*

Stapleton, M. F., *United States Bureau of Fisheries, Mammoth Spring, Ark.*

Starbuck, Alexander, *Cincinnati, O.*

Starr, W. J., *Eau Claire, Wis.*

Steele, G. F., *Port Edward, Wood County, Wis.*

Stevens, Arthur F., *227 West Grand Street, Elizabeth, N. J.*

Stevenson, Charles H., *United States Bureau of Fisheries, Washington, D. C.*

Stewart, A. T., *Northville, Mich.*

Stone, Charles A., *Plainfield, N. J.*

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

Story, John A., *East Orland, Me.*

Stotz, Martin, *996 N. Marshall Street, Crogin Bldg., Philadelphia, Pa.*

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

Stranahan, F. A., *Cleveland, O.*

Streeter, H. R., *Carolina, R. I.*

Sumner, Dr. Francis B., *College of the City of New York, New York City.*

Storr, Charles A., *care of Plympton Gardner & Co., New York.*

Surber, Thaddeus, *United States Bureau of Fisheries, White Sulphur Springs, W. Va.*

Suthers, Frank, *Madison, Wis.*

Sykes, Arthur, *Madison, Wis.*

Sykes, Henry, *Bayfield, Wis.*

Talbot, Henry, *Interstate Commerce Association, Washington, D. C.*

Tankerslay, A. S., *United States Bureau of Fisheries, Tupelo, Miss.*

Taylor, Robert Kirby, *66 Leonard Street, New York City.*

Teal, J. N., *Worcester Block, Portland, Ore.*

Thayer, W. W., *234 Joseph Campau Avenue, Detroit, Mich.*

Thomas, Henry G., *Stowe, Vt.*

Thompson, George B., *Davis, W. Va.*

Thompson, James F., *Martinsburg, W. Va.*

Thompson, William H., *Secretary Anglers' Association of St. Lawrence River, Alexander Bay, N. Y.*

Thompson, W. P., *112 Broad Street, Philadelphia, Pa.*

Thompson, W. T., *United States Bureau of Fisheries, Leadville, Col.*

Tinker, E. F., *St. Johnsbury, Vt.*

Titcomb, John W., *United States Bureau of Fisheries, Washington, D. C.*

Townsend, A. A., *Carolina, R. I.*

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

Tubbs, Frank A., *Neosho, Mo.*

Tulian, Eugene A., *Oficina, Meteorologica, 640 Viamonte, Buenos Ayres, Argentina.*

Turner, Avery, *Vice President and General Manager of Pecos Valley Lines, Amarillo, Tex.*

VanDusen, H. G., *Master Fish Warden of Oregon, Astoria, Ore.*

Veeder, John J., *Woods Hole, Mass.*

Venn, Harry S., *United States Bureau of Fisheries, Washington, D. C.*

Vincent, W. S., *United States Bureau of Fisheries, Cape Vincent, N. Y.*

Vogelsang, Alexander T., *Mills Building, San Francisco, Cal.*

Von Bayer, Hector, *United States Bureau of Fisheries, Washington, D. C.*

Von Lengerke, J., *318 Broadway, New York City.*

Walker, Bryant, *Detroit, Mich.*

Wall, Joe, *Salmon, Ore.*

Wallett, W. H., *Put-in-Bay, O.*

Wallich, Claudius, *United States Bureau of Fisheries, Oregon City, Ore.*
Walsh, Joseph, *Woods Hole, Mass.*
Walters, C. H., *Cold Spring Harbor, N. Y.*
Ward, Prof. H. B., *Lincoln, Neb.*
Waterhouse, Rev. E. M., *Broadway and 210 W. 72nd Street, New York City.*
Webb, W. Seward, *44th Street and Vanderbilt Avenue, New York City.*
Wentworth, E. E., *United States Bureau of Fisheries, Baker, Wash.*
Wheeler, Charles Stetson, *2413 Washington Street, 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.*
Willard, Charles W., *Westerly, R. I.*
Wilson, C. H., *Glen Falls, N. Y.*
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.*
Wood, C. C., *Plymouth, Mass.*
Wood, Frank, *Edenton, N. C.*
Worth, S. G., *Edenton, N. C.*

Young, Capt. John L., *Atlantic City, N. J.*

Zacharie, Col. F. C., *345 Corondelet Street, New Orleans, La.*
Zweighapt, S., *Deer Park, Haines Falls, N. Y.*
Zalsman, P. G., *Paris, Me.*

HONORARY.

Adams, Mr. Fred J., *Grand Rapids, Mich.*

Besana, Mr. Guiseppe, *President Lombardy Fishery Society, Via Torino 51, Milan, Italy.*

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.*

*Hoek, Prof. P. P. C., *Scientific Fishery Adviser of the Dutch Government, The Hague, Holland.*

Hofer, Prof. Dr. Bruno, *Munich, Germany.*

Johnson, Mrs. Frank M., *Boston, Mass.*

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.*

Perrier, Prof. Edmond, *Director National Museum of Natural History, Paris, France.*

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

Steindachner, Prof. Dr. Franz, *Royal Natural History Museum, Vienna, Austria.*

The Governors of the Several States.

The President of the United States.

Vinciguerra, Dr. Decio, *Director Royal Fish Cultural Station and Aquarium, Rome, Italy.*

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*On furlough until autumn 1907, as General Secretary to the International Council for the Study of the Sea, Copenhagen, Denmark.

Von Grimm, Dr. Oscar, *Inspector-General of Fisheries, St. Petersburg, Russia.*

Von Pirko, Mr. Franz, *President Austrian Fishery Society, Vienna, Austria.*

Woodmount Rod and Gun Club, *Washington, D. C.*

CORRESPONDING.

Ayson, Lake F., *Wellington, New Zealand.*

Ayson, Charles L., *Hakataemen, Oamaru, New Zealand.*

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

Armistead, J. J., *Dumfries, Scotland.*

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

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

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.*

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

Olsen, O. T., *Grimsby, England.*

Raveret-Wattel C., *Director of Agricultural Station at Nid-de-Verdier, 20 Rue des Acacias, Paris.*

Sars, Prof. G. O., *Christiania, Norway.*

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

Trybom, Dr. Filip, *Stockholm, Sweden.*

RECAPITULATION.

Active	387
Honorary	70
Corresponding	16
Total Membership	473

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of 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 discussion of same.
   (Note—a. In the reading of papers preference shall be given to the members present.
   b. The President and two Secretaries are empowered to arrange the papers of the meetings of this 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.

The thirty-sixth annual meeting of the American Fisheries Society will be held in July, 1907, at Erie, Pennsylvania, U. S. A.