TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Twenty-ninth Annual Meeting

JULY 18, 19 AND 20, 1900.

Headquarters of the Meeting, United States Fish Commission Station, Woods Hole, Massachusetts.

DETROIT:
SPEAKER PRINTING CO.,
1900.

OFFICERS FOR 1900-1901.

President, . . .	F. B. DICKERSON, Detroit, Mich.
Vice-President, . .	GENERAL E. E. BRYANT, Madison, Wis.
Treasurer, . . .	C. W. WILLARD, Westerly, R. I.
Recording Secretary, . .	SEYMOUR BOWER, Detroit, Mich.
Corresponding Secretary,	W. DE C. RAVENEL, Washington, D. C.

EXECUTIVE COMMITTEE.

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DR. B. W. JAMES, Philadelphia, Pa.

ROBERT HAMILTON, Greenwich, N. Y.

ALDEN SOLMANS, South Norwalk, Conn.

J. J. STRANAHAN, Bullochville, Ga.

NATHANIEL WENTWORTH, Hudson Centre, N. H.

HENRY O'MALLEY, Baker, Wash.

PREFACE.

As many into whose hands the Transactions will fall have little or no interest in such of the proceedings as relate solely to business matters and business procedure, it has seemed best to the Secretary to compile all transactions of a routine or incidental nature into one body as Part One, and the papers and discussions into a separate body as Part Two. It is believed that this plan will also facilitate reference and thus help to make the Transactions more acceptable to all.

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PART I

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Wednesday, July 18, 1900.

The meeting was called to order by President Titcomb at 10:30 a. m.

The following old and new members were in attendance at one or more of the sessions at Woods Hole and on the steamer Fish Hawk:

Name.	Address.
Bennett, S. R.	New Bedford, Mass.
Bowers, George M.	Washington, D. C.
Bower, Seymour	Detroit, Mich.
Brewster, C. E.	Grand Rapids, Mich.
Bryant, Gen'l E. E.	Madison, Wis.
Bumpus, Dr. H. C.	Providence, R. I.
Clark, Frank N.	Northville, Mich.
Corliss, C. S.	Gloucester, Miss.
Davis, H. W.	Grand Rapids, Mich.
Dickerson, F. B.	Detroit, Mich.
Dinsmore, A. H.	Green Lake, Maine.
Edwards, Vinal N.	Woods Hole, Mass.
Geer, E. H.	Hadlyme, Conn.
Hahn, Capt. E. E.	Woods Hole, Mass.
Hamilton, Robert	Greenwich, N. Y.
Handy, L. B.	South Wareham, Mass.
Hubbard, Waldo F.	Nashua, N. H.
Huntington, L. D.	New Rochelle, N. Y.
Hurlbut, H. F.	East Freetown, Mass.
James, Dr. Bushrod W.	Philadelphia, Pa.
Jennings, G. E.	New York City.
Lane, G. F.	Silver Lake, Mass.

Locke, E. F. ..... Woods Hole, Mass.
Mathewson, Geo. T. ..... Thompsonville, Conn.
Mead, Prof. A. D. ..... Providence, R. I.
Milliken, Dr. J. D. ..... Woods Hole, Mass.
Morse, Grant M. ..... Portland, Mich.
Nevin, James ..... Madison, Wis.
O'Malley, Henry ..... Baker, Washington.
Peabody, Geo. F. ..... Appleton, Wis.
Proctor, Redfield ..... U. S. Senator, Vermont.
Ravenel, W. de C. ..... Washington, D. C.
Root, Henry T. ..... Providence, R. I.
Smith, Dr. H. M. ..... Washington, D. C.
Smith, Capt. J. A. ..... Woods Hole, Mass.
Thompson, W. T. ..... Nashua, N. H.
Titcomb, John W. ..... St. Johnsbury, Vt.
Wentworth, Nathaniel ..... Hudson Centre, N. H.
Willard, C. W. ..... Westerly, R. I.
Wood, C. C. ..... Plymouth, Mass.

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

Name.	Address.
Adams, Fred J.	Grand Rapids, Mich.
Ainsworth, C. E.	Sault Ste. Marie, Mich.
Allen, G. R.	Roxbury, Vt.
Andrews, A.	Columbus, Ga.
Bailey, H. W.	Newbury, Vt.
Bennett, S. R.	New Bedford, Mass.
Blatchford, E. W.	Chicago, Ill.
Boyce, F. C.	Carson City, Nev.
Brewster, C. E.	Grand Rapids, Mich.
Brewster, W. K.	Durand, Mich.
Bullard, C. G.	Kalamazoo, Mich.
Chambers, A. E.	Kalamazoo, Mich.
Chase, H. C.	Philadelphia, Pa.
Collins, J. C.	Providence, R. I.

Carlo, G. Postiglione de.....Naples, Italy.
Cobb, E. W.....St. Johnsbury, Vt.
Cogswell, J. M.....Washington, D. C.
Cohen, N. H.....Urbana, Ill.
Corliss, C. S.....Gloucester, Mass.
Coulter, A. S.....Charlevoix, Mich.
Dunlap, I. H.....Washington, D. C.
Edwards, Vinal N.....Woods Hole, Mass.
Fearing, D. B.....Newport, R. I.
Geer, E. H.....Hadlyme, Conn.
Greene, Myron.....Franklin, Vt.
Hahn, E. E.....Woods Hole, Mass.
Hamsdale, Frank.....Madison, Wis.
Hogan, J. J.....Madison, Wis.
Handy, L. B.....South Wareham, Mass.
Hoxie, Chas. A.....Carolina, R. I.
Hubbard, W. F.....Nashua, N. H.
Hughes, Frank L.....Ashland, N. H.
Jensen, Peter.....Escanaba, Mich.
Joseph, D.....Columbus, Ga.
Kenyon, A. W.....Usquepang, R. I.
Lamkin, J. Bayard.....Bullochville, Ga.
Lane, Geo. F.....Silver Lake, Mass.
Lawton, J. P.....Columbus, Ga.
Locke, E. F.....Woods Hole, Mass.
Lovejoy, Samuel.....Bullochville, Ga.
Mathewson, G. T.....Thompsonville, Conn.
Mead, A. D.....Providence, R. I.
Milliken, J. D.....Woods Hole, Mass.
O'Connor, E. M.....Savannah, Ga.
O'Malley, Henry.....Baker, Washington.
Peck, Stephen.....Warren, R. I.
Proctor, Redfield.....Proctor, Vt.
Robinson, A. H.....St. Johnsbury, Vt.
Rodgers, Frank A.....Grand Rapids, Mich.
Self, E. M.....Bullochville, Ga.
Schweikart, Walter.....Detroit, Mich.

Sellers, M. G. ..... Philadelphia, Pa.
Solmans, Alden ..... South Norwalk, Conn.
Starr, W. J. ..... Eau Claire, Wis.
Sykes, Arthur ..... Madison, Wis.
Seagle, G. A. ..... Wytheville, Va.
Smith, H. M. ..... Washington, D. C.
Smith, J. A. ..... Woods Hole, Mass.
Stewart, Chas. E. ..... Westerly, R. I.
Thompson, W. P. ..... Philadelphia, Pa.
Thompson, W. T. ..... Nashua, N. H.
Tinker, E. F. ..... St. Johnsbury, Vt.
Trumpour, D. A. ..... Bay City, Mich.
Tucker, E. St. George ..... Halifax, N. S.
Vincent, W. S. ..... Leadville, Colo.
Vogelsang, A. F. ..... San Francisco, Cal.
Wentworth, Nathaniel ..... Hudson Centre, N. H.
Wilbur, P. H. ..... Little Compton, R. I.

The President: Gentlemen, you have not assembled here to listen to an inaugural address, and I am going to detain you but a few minutes, in assuming the honor of presiding over your deliberations during this convention. As the duties of the President have been established by custom rather than by the Constitution, the work of presiding at the annual meeting is about all that you will expect of me.

I have conducted more or less correspondence during the year in attempting to keep up and increase the membership of the society. In this work I have had the hearty support of your efficient Secretary. In looking over the printed transactions for the past ten years I find that the highest number of members were enrolled in 1894, there being on the books at that time 267. Undoubtedly many of that list were not paying members, and the records of 1896 indicate that many were weeded out, the total number enrolled being only 146. Since 1896 the membership has been gradually increasing until today we have recorded on our books 204 names, besides the ones to be proposed at this meeting. Of the 204 names, 20 are not regularly members until

the action of your President and Secretary has been ratified. After the last annual meeting we sent out a circular letter addressed to all State Fish Commissioners not already members, and to all others whom we thought ought to be members. The twenty who responded paid their dues as of last year, and received the literature of the Society as regular members. I understand that the present membership list is all an active one, the delinquent members having all been dropped last year.

The call for the present meeting has been sent to all Governors of States, requesting that delegates from their Fish Commissions be sent to the meeting. I do not quite understand why we do not have more members from State Fish Commissions, inasmuch as the reports of the transactions of the Society are worth much more than the annual membership fee to all enterprising and progressive Fish Commissioners. Perhaps I may mention the additional profit from personal intercourse and comparison of notes by the members who are able to attend the annual meetings; while we learn much from the papers and their discussion, I find that on special subjects we learn much more by personal contact with others interested in similar lines of work. It appears, however, that we cannot secure new members very rapidly except by personal solicitation, and to that end I urge all members to think over the list of eligible members in their respective States, and then induce these eligibles to join the Society.

As we have an unusually large number of papers to be read and discussed, I will endeavor to dispatch the routine business as rapidly as possible.

The first business before the meeting would perhaps be the reading of the Secretary's report, but I would suggest that inasmuch as we have present with us some would-be members, that we immediately act upon the applications for membership before doing any further business, and to that end I will ask you to file applications for membership. I will change that order a little, and suggest first that you propose a temporary treasurer in

the absence of the regular treasurer. I understand that Mr. Huntington will not be here until later.

On motion, Mr. H. W. Davis was elected to act as temporary treasurer.

The President: In connection with the applications for membership I will say that last year we took in, under the circular that you received, 20 members. I will ask the Secretary to read the names of those taken in by the President and Secretary for your ratification.

After the reading of the names, a motion declaring the gentlemen duly elected as members of the Society, was unanimously carried. These names, together with all others presented and elected during the several sessions, are included in the list printed elsewhere in the transactions.

On call of President Titcomb, the Secretary then read the following report:

REPORT OF THE RECORDING SECRETARY.

To the Members of the American Fisheries Society:

GENTLEMEN: Since the last annual meeting, four circulars have been issued, three for mailing to the members and to others who might be induced to become members, and one for mailing to the Governors of the States. The text for these circulars was prepared, for the most part, by President Titcomb. I am also indebted to the President for assistance and favors in many other ways, rendering the duties of the Secretary less onerous to that extent, and for all of which grateful acknowledgment is hereby tendered. I desire to add that the thanks of every member are due to the President for the zeal and tireless energy he has displayed at all times in furthering the interests of the Society.

The correspondence during the past year has been quite voluminous. Owing to absence from home a considerable portion of the time, it has been impossible for me to attend to the business that arose as promptly as might be desired, for which

I ask the indulgence of the members. I also crave the indulgence of some of the Western members for taxing their patience with persistent personal appeals for contributions for this meeting, the Eastern members being left to the tender mercies of the President.

The active membership list as furnished by the Treasurer, and published in the report for 1899, contains 184 names, a net gain of 28 over the preceding year. A noticeable feature in connection with the published list is the date of admission to membership, so far as this could be ascertained by the Treasurer. I suggest to members who may have knowledge of the missing dates that they communicate with the Treasurer at their earliest convenience.

I am unable to state the exact number of names that were dropped this year for non-payment of dues; nor have I the data showing the number of resignations and deaths. Conspicuous in the list of the latter are the names of Col. Fred Mather and Herschel Whitaker, the former one of the founders of the Society, the latter an ex-President and ex-Secretary, and both widely known through their contributions to the literature of fish-cultural and kindred subjects, and I suggest that suitable action thereon be taken by the Society.

The report for 1899 was printed at the lowest competitive bid, 75 cents per page for 500 copies, or eight cents less per page than the report for 1898, bringing the cost of the entire edition for 1899 below $100. These reports were not completed and ready for mailing until early in December, the issue being delayed in part by my absence from headquarters for days and weeks at a time, and for other reasons.

Partly through the advice of the President, and partly on my own judgment, a more liberal policy in the matter of distributing reports has been adopted. Of the edition for 1899, 434 copies have been disposed of, leaving 66 on hand. I have also distributed about 100 copies of back reports to members, on application.

I herewith submit an inventory of the reports in my hands at the present time:

Year.	Number of Copies.
1892	1
1893	6
1894	13
1895	124
1896	143
1897	200
1898	191
1899	66
Total	744 copies.

During the year I have received 23 applications for membership, accompanied with the regular membership fee. July 12th I forwarded to the Treasurer a certified statement of all funds received and disbursed by me for the Society up to and including that date.

Respectfully submitted,

SEYMOUR BOWER,

Recording Secretary.

On motion the report of the Secretary was accepted and adopted.

The President: The next business in order naturally would be the reading of the Treasurer's report, but this will have to be suspended until his arrival. The next will be the Corresponding Secretary's report.

REPORT OF CORRESPONDING SECRETARY.

The correspondence during the year has been mostly with editors of magazines, newspapers, and members of the Society. Foreign correspondence sought for nothing new. Quite a number of letters received suggesting that we take some action thanking eastern societies for their success in checking the killing of our song birds.

Several members suggest that the United States Fish Commission should have national distributing points for the collection of small fish for distribution in our inland streams. Some of our eastern members ask if our United States Fish Commission could bring to America a few of the very desirable fish found in the island streams of Cuba, Philippines and other new possessions.

A question is asked by one of our leading State Fish Commissioners: "Why is it that our State Fish and Game Commissioners do not take a greater interest in this Society? Each State should be in close touch with the American Fisheries' Society through their Fish and Game Commissioners. No trouble to get recognition from legislative authority if properly pushed."

All letters have been promptly answered.

J. E. GUNCKEL,
Corresponding Secretary.

On motion the report of the Corresponding Secretary was accepted and adopted.

President Titcomb: At any time during this meeting I will suggest that if there are any errors in the printed report of the transactions of the Society last year, as noticed by any members—any errors in addresses or changes in addresses, that they be brought to the attention of the Secretary.

It is customary to appoint some committees, and your Secretary has recommended that a Committee on Resolutions be appointed. What action will you take on that?

On motion of Mr. James, the President was authorized to appoint a committee of three, and the following gentlemen were named:

COMMITTEE ON RESOLUTIONS.

Dr. B. W. James, of Pennsylvania.
G. F. Peabody, of Wisconsin.
H. W. Davis, of Michigan.

The President: The next business in order will be the

nomination of officers for the ensuing year. What action will you take?

On motion of Mr. Clark, the President was instructed to appoint a nominating committee of five, and the following gentlemen were named:

COMMITTEE ON NOMINATIONS OF OFFICERS.

Frank N. Clark, of Michigan.
Dr. H. C. Bumpus, of Rhode Island.
George F. Peabody, of Wisconsin.
W. de C. Ravenel, of Washington, D. C.
Nathaniel Wentworth, of New Hampshire.

President Titcomb: I would suggest to the committee that perhaps they will wish, before making their report, to wait until more members have arrived. We shall have today members from other States, and quite a number are expected; I know all three of the Commissioners from Connecticut are coming. I suggest that perhaps we ought to get through with as much business of this kind as possible, so that we can give our time to the papers. It is customary to appoint a committee on time and place for the next meeting.

On motion, the Chair was instructed to appoint three members to act as such committee. The names were not announced at the time, but later the following gentlemen were appointed:

COMMITTEE ON TIME AND PLACE OF NEXT MEETING.

Henry T. Root, of Rhode Island.
Grant M. Morse, of Michigan.
Dr. B. W. James, of Pennsylvania.

President Titcomb: Are there any reports from committees of last year?

The Secretary: None.

The President: Perhaps it would be well to take up at this

time, in connection with the program of the Society and the work before us, the part that relates to recreation. I find that we can hold meetings very conveniently on either the Grampus or Fish Hawk and read our papers at the same time. It was suggested in this program that a visit be made to one or more of the commercial trout hatcheries, and I have had correspondence with Mr. Wood, the superintendent of the hatchery at Plymouth, and Mr. Hurlburt of East Freetown. Mr. Wood holds forth a very attractive program for us, but I am going to be perfectly candid and present the drawbacks to all. The visit to Plymouth will give you an opportunity to visit three or four hatcheries, but it will be a three or four hours' trip on the cars, and those that have just come from Boston will probably not care to go through that torrid atmosphere again. Mr. Hurlburt has a hatchery eight miles from New Bedford. We can take the Fish Hawk and read papers on board the boat, arriving at New Bedford in about an hour and a half, and take an electric car to East Freetown, and then have a 13 minutes' walk through the woods to his hatchery. There you can see a typical hatchery for raising trout for the market, where they do business for what there is in it, and we can have an electric car to ourselves to go up and return. We can then have dinner at New Bedford. The only expense for the trip will be for this dinner, which we can arrange for beforehand as soon as we know how many will go. Possibly there are other representatives of commercial hatcheries here who would like to present invitations, and before this is acted upon I would inquire if there are any such.

The Secretary: I want to say that I have received a very cordial invitation from Mr. Handy, of South Wareham, to visit his hatchery. I supposed I had his letter here, but I must have mislaid it. Mr. Handy is here and perhaps will speak for himself.

Mr. Handy: You can leave here at 2:20 and arrive at South Wareham at 3:20, and I will then take you over to my place. You can leave there at 6:38, and arrive here in an hour; a short trip. I have a commercial hatchery, 75,000 two and three-year-

old trout, and possibly as many more fry, and I guess I have the longest stretch of ponds of anybody in the State, probably not the largest stream of water. I will make all arrangements to get you to the hatchery and back to the station, and you will have three hours at the hatchery.

The President: I would suggest, to save time and to get this matter in shape, that a committee of three might properly be appointed, for any further representatives to present the conditions of getting back and forth, and without further action I will take it as your pleasure to appoint such a committee. I will appoint Mr. Dickerson, Mr. Nevin and Mr. O'Malley, and request that they meet and report as soon after dinner as possible. Are there any other matters to come up?

Dr. Bushrod W. James: I understand there is to be an international meeting of the fisheries interests in Paris this year during the exposition. The matter came before our Society in Pennsylvania, and one of our members, Mr. B. L. Douredoure, was to be there about the time of the meeting—I think the early part of next month—and we appointed him as our delegate from Pennsylvania, or our Society did at least, as the representative of the Society at that meeting. He was to let me know, and I am waiting for a letter from him now. He is probably in Paris long before this. I think it would be well if this Society would appoint any one that is over there, a representative at that meeting. I make a motion to that effect.

The President: You have heard the motion; are there any remarks?

Mr. Clark: Mr. Chairman, I would call attention to the fact that at the Omaha meeting Mr. Whitaker, Prof. Birge and myself were appointed delegates to that congress, but of course I do not expect to go.

The President: By this Society?

Mr. Clark: By this Society. Of course I call attention to it not on my own account, because I do not expect to go. I do not know what provision Prof. Birge has made, but Mr. Whitaker is gone. I would very much like to see the Society

represented. I would not hold by the action taken at Omaha, and now move to amend the motion in such a way as to add to the committee Mr. Douredoure and other members who may be in Paris.

General Bryant: Professor Birge, of Wisconsin, will not be able to attend.

Dr. James: I will accept the amendment of Mr. Clark.

The President: You have heard the motion as amended, and the amendment has been accepted, that Mr. Douredoure or any other members of this Society who may be present in Paris during the International Fisheries Congress, be added to the committee appointed at Omaha to attend this congress.

Motion carried.

The President: I did not think, when I suggested that the committee on entertainment meet after dinner to report, that it is rather desirable for the members representing commercial hatcheries to know as early as possible in order that they may make arrangements at the other end. I suggest that the committee meet such representatives on the piazza and decide at once what trip we will take, so we can act on it right here. Have you any other business at this present time? If not, I have another matter to present. It was suggested by one of the members who joined the Society today, that we have a provision for life membership. A great many people object to paying one dollar a year; they will neglect paying one dollar a year much more quickly than if it were $10. It seems to me that we could amend the constitution, and I see that we can do so by a two-thirds vote. I will read article 2 of the constitution. I was going to suggest that it might be proper to add this to article 2 as section 2, which shall read:

> "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."

Mr. Clark: I move that the constitution be amended as suggested by the President.

The President: Gentlemen, it has been moved that article 2 of the constitution be amended by adding section 2, to read as follows: "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."

Mr. Davis: Do the words "a two-thirds vote" apply to all the members, or only to those present.

The President: I think it would intend to mean a two-thirds vote of the members present. The constitution is vague, but the wording is the same as in the original section. Is there any discussion as to the amount of this life membership fee?

Mr. Clark: I see only one difficulty that is likely to arise. With a fee as small as that, it is barely possible that within the next year or two one-half the members might conclude to become life members; they might say, it is such a bother to pay every year. I will become a life member by paying fifteen dollars, and they pay it. We would be pretty flush for a year or two, and we would do something with that money, and then we would not have our annual dues to fall back on. There is a difficulty that may present itself. May be I am crossing a bridge before I come to it. I am not so sure but I might be one of those, when I had fifteen dollars I didn't want to use right off, to pay for a life membership. There is the one difficulty, it seems to me, if you make the life fee as low as that.

Mr. Morse: Mr. President, I think this is a very good idea. I think it would be an incentive to life members to induce new members to join in order to keep up the Society.

Resolution adopted.

The President: I have here a letter from Dr. R. O. Sweeny, of Duluth, one of the old members of the Society, who has been an officer at times and contributed papers.

The Secretary: Doctor Sweeny is one of the pioneer fish-culturists of this country, and for many years was one of the most active and prominent members of this Society. I think we should recognize his worth and ability by making him an honorary member for life. I make that as a motion. I know of no one

who so well deserves this distinction, and would like to hear from some of the older members who are acquainted with the doctor.

Dr. James: I will second that motion. Mr. Sweeny has done good work in the Society, and we can only honor ourselves and him by electing him an honorary member.

Mr. Clark: I would like to add a word for the good Doctor. I have known him and in connection with this Society for a good many years. I think I met Dr. Sweeny at the meetings of this Society twenty years ago; he was a very active member, and a man that has done a great deal for fish-culture and for this Society. I think the Society will be doing a noble act to honor him in this way.

Motion unanimously carried.

In reply to a notice of the action taken by the Society, Dr. Sweeny wrote as follows to the Secretary:

"I am very much gratified by your letter, announcing the great and unexpected honor of my election to honorary life-membership, conferred upon me by the American Fisheries Society at the Woods Hole meeting. Convey to the members my sincere regards and thanks for the compliment, which I greatly appreciate, and shall ever prize as one of the kindliest I have ever received from my many friends, and I thank yourself for the kind remembrance of me in my old days and retirement from activity in the great work in which you are engaged, and in which I have been so many years greatly and actively interested.

"My health is such now that I keep close at home, and although there is a trout stream almost at my door, I am seldom in condition to scramble along its shores as I would dearly love.

"Believe me I am deeply touched by the kindly action of the dear old friends and members of the Society, and again thank you, one and all, and wish you success in your good work, and that luck will attend every cast, and that you may always come home happy and with full creels of finny spoil."

REPORT OF THE COMMITTEE ON RECREATION.

Mr. Dickerson: We have decided that owing to the fact

that we can go ahead with our meeting on the boat, the better way will be to go to New Bedford and visit the hatchery near there; then if by tomorrow night we find we are going to have time to go to Plymouth and visit those hatcheries, that is a matter that can be acted upon later. I desire to say in this connection that the superintendent of the Michigan hatcheries is going to visit a number of hatcheries, and I believe he will derive a great deal of benefit from it. I think it is to the advantage of the Society to encourage visits to these hatcheries. Mr. Nevin states that he is going to visit a number of them, so that representatives will visit many of the hatcheries anyway, whether we do as a body or not. Our report is, that we go to East Freetown via New Bedford.

On motion, the report of the committee was adopted.

The President: We will leave here at 8:30 tomorrow morning on the steamer Fish Hawk for New Bedford. I would say that the Rhode Island Fish Commissioners have cordially invited the Society to be their guests at a Rhode Island clam-bake at Oyster Bay, and to make an investigation of the oyster beds. It has been suggested by Dr. Bumpus that Friday be devoted to this purpose, and we can read the papers, if any are left to read, on that day, on board the Fish Hawk.

What action will you take, gentlemen, in reference to that invitation? It was thought that many might wish to go home direct from Providence. The steamer will go to Providence, so that many of you can get home from there earlier than from here.

On motion of Mr. Peabody, the invitation of the Rhode Island Fish Commission was accepted.

The President: We have a little more detail business to come before the meeting. I have here a communication from Mr. Charles B. Reynolds, the editor of the "Forest & Stream," New York. I wrote Mr. Reynolds in reply to this letter that there were two sides to the question, that with a fee of only one dollar it seemed as if all persons interested in fish-culture ought

to be willing to pay one dollar in order to receive the papers read at these meetings, and that I should present this matter to the Society for consideration. I would like to hear it discussed.

Dr. James: It seems to me after a paper is read and is public property that any journal might have the privilege of publishing it. I hardly feel that they should have all the papers presented, as we shall want them for our volume. Anyone that has an extra copy should have the privilege of printing it in such papers as he chooses. After they are read they are the property of this Society, but not before.

The President: I think it has been the custom of this Society to give the papers out. The Society feels that after the original papers have been presented here and read they are our property, but there has never been any objection by the Society against individual members loaning them to any journal. Are there any further remarks in reference to this letter of Mr. Reynold's?

Mr Clark: Why is it necessary for us to take any action in the matter at all? It seems to me if it has been the custom for any member to turn over a copy of his papers to the Forest and Stream, that he may continue to do so.

The President: Why not make a motion that the members are at liberty to furnish their papers to the Forest & Stream if they see fit.

Mr. Clark: I then move that the Secretary be instructed to notify Mr. Reynolds to that effect.

The President: You have heard the motion that the Secretary be instructed to notify Mr. Reyonlds, in reply to his letter, that the individual members may furnish duplicate copies of their papers to the Forest & Stream, the Society to retain the originals as its own property.

Mr. Morse: As I understand your statement of the motion, the individual members may present him duplicate copies. I think it ought to be so arranged that other publications could get the papers, too. I would make it so broad that the authors may give copies to any publication that they see fit.

The President: As I understand the motion, it is the sentiment of the Society that members furnishing papers are at liberty to furnish duplicates to any paper; that the Secretary be instructed to inform Mr. Reynolds and other papers to this effect. I would ask that the originals be considered the property of this Society.

Mr. Clark: I cannot help calling the attention of the members to one thing in this connection. Fifteen or eighteen years ago this same question was agitated in this Society. At that time the Forest & Stream had what might be called a cinch on the papers. Our deceased member, Fred Mather, was connected with that publication, and that went along for a year or two; then we gave our papers to the American Field, the Forest & Stream, and I don't know but one other publication. That went along for a time until a number were grabbing for the papers, and I don't know, but it seems to me we are going to land just where we did fifteen or twenty years ago. It was then decided that the best thing to do was simply not to give them to any publication; anyone that wanted them must join the Society. Now, if we are not a little careful we are going to drift into that same trouble. We had two or three sessions that were very warm over this same question. It was said then that the papers ought really to go to the public. I admit that they are for the purpose of instructing the people in the lines of our work, but I fear you will have some trouble on the start.

Mr. Davis: I heartily concur in the remarks of Mr. Clark; the articles presented here are valuable, they are very valuable, and many are anxious to get them. I have had letters and applications for them from a great many, but it strikes me that the public is not entitled to these publications unless they pay for them. We pay for them and spend our time, the members prepare these articles and they are valuable, and I do not know why they should be given gratuitously to all the papers; they can get all the proceedings here, the gist of them, through the newspaper reports of the meeting.

Mr. Ravenel: We simply leave it optional with the author.

Dr. James: Quite a large society that I am a member of had the same question before it not many years ago, and we found it necessary to limit it so that after a paper was read and discussed in the society the author was allowed to do what he pleased with it. There were some twenty or thirty journals interested in our meetings, and they were all looking for the papers from that organization, and so the fishing journals want to have these papers, and I see no reason why the people should not read these articles. It is claimed that many will not attend the meetings of the Society because they see the articles in the papers. I should think that would be just the thing to induce them to join, as it will whet their desire to become members rather than keep them waiting to get all the transactions in one mass. It simply resolves itself down to this point, whether we shall allow the journals to write to the members, or whether this Society shall definitely fix that no one shall have any of the papers until our report is out. I am quite liberal in this matter, however, and I think no journal should be made the special authority of this Society for the exclusive use of its members, as seems to have been the case some few years ago. I think all the journals should have access to all the papers from their authors as soon after the meeting is over as possible.

The Secretary: I think the objection raised by Mr. Clark could easily be overcome by the Secretary notifying such papers as are likely to want the articles—there are not over half a dozen of them—that the Society had granted the privilege to members to give out their papers as individuals. But there is another point to be considered. If a member does not retain a copy of his paper exactly as it is presented here, and some do not, how can he furnish a copy of it after it has been read here and turned over to our Secretary?

Mr. Dickerson: It is my understanding that there is no objection to the members furnishing copies of their papers, but the Society should hold the originals; that will cover the whole point and obviate the necessity for any motion. I think there is really no objection to this plan; in fact, we have nothing

to do with it anyway. Of course, no member would desire to give out his paper if he thought there was any objection by the Society.

Mr. Wood: Through courtesy to the Society.

Mr. Bryant: Wouldn't it be well to add that "he is at liberty after the paper has been read before this Society"?

Dr. James: As I said, after the papers were read in this Society. The circular sent out before each meeting gives a list of the papers to be read and the topics. Now, these publications might immediately correspond with the author and request a copy, and if they get the copy in advance they would very likely publish it before it was read here.

Mr. Davis: I think when a member has prepared a paper to be read before this Society, if he should furnish a copy in advance to a newspaper, the Society would hardly permit it to be read here. Papers should not be published until after they are read here.

Mr. Wood: Wouldn't it be a good plan to suggest to the Forest & Stream to correspond with the members?

Mr. Clark: I still insist that it does not seem to me we are going at this thing right. Before a paper is presented here it does not belong to this Society, and no one has a right to publish it as a paper read at a meeting of the Society. If the members think it is best to give them out after a meeting, let the Secretary be instructed to notify all the leading fishing journals that they are at liberty to have these papers by paying the expense of a typewritten copy. If it is to be done at all, let the Society do it and notify the Forest & Stream that they are at liberty to have all the papers; American Field and others the same, and if it is in order I move to amend so as to direct the Secretary to furnish typewritten copies to all the leading fish journals requesting a copy, such journals to pay the expense of the typewritten copy.

Dr. James: Would that allow the author to send two or more copies? A member might send two copies to the Secretary, who might select one or the other; it is then upon the Secre-

tary whether he shall send to the Forest & Stream or some other publication.

Mr. Clark: My idea is, that the Secretary should write to such journals and tell them that they can have any of the papers of the Society by paying for a typewritten copy.

Dr. James: My idea is, whether the author shall furnish several copies or only his own individual copy. He might furnish two copies, and in that case it would only go to one journal. The author might make journal duplicates himself.

Mr. Clark: The author should have nothing to do with it, should not control it after it comes here and becomes the property of the Society. But if one journal is allowed to have the papers, all should have the same privilege; they should be furnished by the Society, not by the authors.

Mr. Ravenel: What do we gain by that? We only add to the work of the Secretary, which is already a labor of love and not pay, and we compel the Society to do this when I thought it was the feeling to leave it optional with the authors.

The President: If you will excuse the Chair, I would like to say a word on this subject. Undoubtedly some members of this Society want their papers published. It has been customary for some of them to give their papers to different journals; I know I have given my paper to the Fishing Gazette. I always make my own copy in duplicate. It seems to me as to this I am ready to do, personally, whatever the Society wishes, but I do not think we can control any member as to his paper. He reads his paper here, and then if he chooses to give it to any journal it is his own business. We have his original, and if he chooses to give a copy of his paper to any journal we cannot control it; he has a right to do so; it is not copyrighted. It seems to me that the present resolution governs that point.

Mr. Bryant: Suppose Mr. Nevin writes a paper, and half a dozen newspapers in his State would like to publish it, and they make a request to him for it. The resolution as proposed, it seems to me, is more liberal than the amendment, which would compel them to apply to the Secretary and pay for a copy. That

would tend to turn everything into the leading fish journals, instead of leaving the author at liberty to get a little more publicity.

The Chair then put the question on the amendment of Mr. Clark, which was lost by a close vote. The original motion was then carried.

The President: I have been informed that Mr. Wood, Superintendent of the Plymouth Rock Trout Co., is ready to read his paper and desires to give it this afternoon, and I take it to be your pleasure that his be the first paper to be read.

I am happy to say that our Treasurer has arrived and will soon be ready to present his report.

I would like to inquire if there are any other members who would like to have their papers put ahead of others, that is, who are desirous of getting off early; this inquiry can be answered at any time, either to me or to the Secretary during the day, so that the work will run along as rapidly as possible.

Is there any further business before this meeting? I want to dispose of one more matter. The Secretary informs us he has a lot of back copies of our annual reports. They are valuable and we have applications for them from new members and others. I suppose it is simply a question of whether we give them away to those who come in at the eleventh hour or have them pay for the actual cost of the publication. Our treasury is not very flush with the present annual dues of only one dollar a year.

The Secretary: The plan that I have followed during the past year was to send out the reports, as far as I could, to any member of the Society who applied for them. The reports of '92 are practically exhausted. In some cases I prepaid the postage and sometimes when the package was large I sent by express, charges collect. I think in that way there were over 100 back reports disposed of during the past year. I think if it were generally understood that these reports are available they would be more generally applied for.

Mr. Clark: I would like to ask if it is understood that a

member may have a copy for each of the different years, if that is the idea?

The President: It is for this Society to decide how to dispose of them.

Mr. Huntington: Mr. Chairman, I would ask for information if there are back copies of all the respective years, or how far back, and for what years there are copies now in the hands of the Secretary?

(Secretary's report in reference to the above read again.)

The Secretary: I think, Mr. President, that at least five copies, where we have five copies, should be reserved and kept as the property of the Society.

The President: Some of you make a motion to dispose of this question. It seems to me that members who wanted to complete their sets would be ready to pay for them, and new members would be ready to buy their copies.

Mr. Dickerson: I would suggest that the copies be held for new members, and that they be given to new members gratuitously.

The President: Any further discussion of this question, if not, it seems to be left just where it was before. The new members will get them.

Mr. Davis: I make a motion that the new members—including my friend Brewster—be charged 25 cents a copy for all back reports that they call for and receive, and that the old members get them at the same price.

Motion seconded and carried.

On motion of the Secretary, it was ordered that five copies be reserved for the Society and that no issue be sold or disposed of below that number.

Mr. Davis: What is the expense of publishing?

The Secretary: The last reports cost, approximately, 20 cents a piece.

Adjourned until 2 p. m.

AFTERNOON SESSION, WEDNESDAY, JULY 18.

Called to order by President Titcomb at 2:15.

This session was devoted to the reading and discussion, in order, of papers by Mr. Wood, Mr. Brewster and Dr. Bartlett.

Adjourned at 4:20 for a sail on the Grampus. No papers were read nor business transacted on the Grampus.

EVENING SESSION, WEDNESDAY, JULY 18.

Called to order by the President at 8:15. The President announced that annual dues were due and payable and that the Treasurer was ready to receive them, also invited proposals for membership. Eight names were handed in and the gentlemen were duly elected as members of the Society.

The President: Shall we proceed with the reading of the papers or take up the detailed business now?

Mr. Ravenel: I would like to say that I will represent the United States Fish Commission at the Pan-American Exposition. Last year I called the attention of the State Commissioners to the fact that we were to have a large aquarium and stated that if any of the eastern states would like to, we should be very glad to show their fishes in the government aquarium, and that we would bear all the expenses of the shipment. Two weeks ago I addressed a letter to many of the State Commissioners, and I have here with me a plan of the exhibit and shall be very glad while here to explain fully any inquiries concerning it. We cannot placard each aquarium saying that these fish are from Massachusetts, etc., but we will publish a report showing where they are from, and we shall be very glad to do so. I would especially like to have the co-operation of the Eastern States, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, New York and Pennsylvania.

The President: About what time will you want to receive the fish?

Mr. Ravenel: We would like to have them for the opening, but it is not necessary that they should be there early in the spring. It does not make a great deal of difference whether they get there on the opening day or not.

Mr. Dickerson: I desire to say that Mr. Ravenel will have the hearty co-operation of the Michigan Commission, and everything will be done that it is possible to do to make the exhibit everything that it should be.

The President: I will say for the Vermont Commission that we shall try and supply them with golden trout, lake trout, and brook trout.

Dr. James: We have several hatcheries in Pennsylvania, and I have not the least doubt but the Fish Commissioners will furnish anything that they can.

Mr. Root: I wish to say on behalf of the Rhode Island Commission that we are making very interesting experiments in the raising of the lobster, and we think we are going to make a success of it, and if we do we shall be pleased to make an exhibit of the lobster and also of oysters and clams. If we do succeed in propagating and raising them I think it will be something that has never been done before. I think there is no doubt but our experiments will be successful.

The reading and discussion of papers was then taken up in the following order: Papers of Mr. Clark, Dr. James, Mr. Babbitt and Dr. Henshall. President Titcomb then announced the programme for the next two days. Adjourned at 10 p. m.

Thursday, July 19, 1900.

On board the "Fish Hawk" for New Bedford.

Meeting called to order at 8:30.

The President: The first business in order will be the reading of the Treasurer's report.

TREASURER'S REPORT.

To the American Fisheries Society:

GENTLEMEN—I herewith submit my Annual Report as Treasurer from June 26th, 1899, to July 18th, 1900.

RECEIPTS.

June 26, 1899, to balance in treasury	$294 56	
1896 dues	12 00	
1897 "	15 00	
1898 "	5 00	
1899 "	151 00	
		$477 56

DISBURSEMENTS.

Acc't of 1898, by Secretary, directing envelopes	$ 1 00	
" 1898, " telegraphing	75	
" 1898, by Treasurer, express	25	
" 1899, J. S. Benner, services at meeting, Voucher No. 1	18 00	
" 1899, G. H. Thurston, stenographer at meeting, Voucher No. 3	60 00	
" 1899, Robert Smith Printing Co., printing proceedings, Voucher No. 4	91 92	
" 1899, account Speaker Printing Co., printing and stationery (2), Voucher No. 5	9 50	
" 1899, by Treasurer, T. Humphrey, printing and stationery (2), Voucher No. 6.	7 50	
" 1900, by Treasurer, typewriting and express	1 25	
" 1900, " postage	11 28	
" 1900, " collecting out of town checks	78	
" 1900, express	25	
July 18, 1900, by Secretary, Voucher No. 7	46 24	
" 18, 1900, by Speaker P't'g Co., Voucher No. 8.	12 50	
	$261 22	
July 18, 1900, balance on hand	216 34	
		$477 56

L. D. HUNTINGTON, *Treasurer.*

We have examined vouchers and find the report of Treasurer as above correct.

GEO. F. PEABODY
L. B. HANDY
WALDO F. HUBBARD
Auditing Committee.

On motion of Mr. Clark the report of the Treasurer was accepted and adopted.

Mr. Clark: I wish to ask the Treasurer what the net increase in membership is.

Mr. Huntington: The net increase in membership over last year? About 24 or 25, I think about that, for the reason that we lost 25 members last year, and 18 of those were gentlemen that I assure you I have not sent less than four communications to, urging the payment of their dues, so that there are now none on the list liable to be marked off.

It has always been the custom to submit the report of the Treasurer to an auditing committee, and I would be very glad indeed to have my account audited by a committee.

The President: The chair will appoint as such committee Mr. Peabody, Mr. Handy, Mr. Hubbard. (See report above.)

The Committee on Time and Place reported as follows:

Mr. Root: I will make the report for the committee, stating that there were but two places named before the committee, Philadelphia and Milwaukee. The gentleman from Philadelphia after listening to the application from Milwaukee very graciously intimated that he thought Milwaukee had a prior claim, which left the duties of the committee nominal almost and they were unanimously in favor of recommending Milwaukee, and also that the time be about the same as this year, that is, we will have to start one day later on the calendar. Your committee unanimously recommend that this Society meet in Milwaukee, on the 19th, 20th and 21st of July.

On motion of Mr. Davis the report of the committee was accepted and adopted.

Mr. Peabody: Wisconsin thanks you for the honor, and I beg to say that the State Fish Commission joins with the citizens of Milwaukee in a cordial invitation to come to Wisconsin next summer.

We propose to take the members of the Society from Milwaukee to Wisconsin's new and magnificent hatchery at Bayfield, on Lake Superior, a night's ride, and more than two hundred miles from Milwaukee.

We have a hatchery there that we think in some respects is better than any other, and this because nature has provided great natural facilities, with an abundance of pure water.

We, from Wisconsin, who have come twelve hundred miles to this meeting, are hopeful that you Eastern people will accept our cordial invitation to come west next summer and prevail upon as many of your friends as possible to join you.

REPORT OF COMMITTEE ON NOMINATION OF OFFICERS.

Mr. Clark: Your committee respectfully submits the following report:

I wish to say, Mr. Chairman and gentlemen, that your committee in making its verbal report wishes to convey the thanks of this Society to every retiring officer, the officers of this Society for the past year; we wish to thank them for their good services.

After considering the names of the members of this Society your committee presents the following for officers for the ensuing year:

For President, Mr. F. B. Dickerson, of Michigan.

For Vic-President, Mr. E. E. Bryant, of Wisconsin.

For Secretary, Mr. Seymour Bower, of Michigan,

For Corresponding Secretary, Mr. W. de C. Ravenel, Washington, D. C.

For Treasurer, Mr. C. W. Willard, of Rhode Island.

Executive Committee:

Mr. Frank N. Clark, of Michigan.

Dr. B. W. James, of Pennsylvania.

Mr. Robert Hamilton, of New York.

Mr. J. J. Stranahan, of Georgia.

Mr. Alden Solmans, of Connecticut.

Mr. Buffington, of Massachusetts.

Mr. Nathaniel Wentworth, of New Hampshire.

Your committee recommends these as the officers for the coming year.

On motion of Mr. Morse, the report of the committee was accepted and adopted, and the officers for the ensuing year declared elected.

President Titcomb called attention to the fact that Mr. Buffington is not a member of the Society. On motion the name of Mr. Henry O'Malley, of Washington, was substituted for that of Mr. Buffington, and Mr. O'Malley was then elected a member of the Executive Committee.

Mr. Dickerson: Gentlemen, I thank you very much for the honor conferred upon me, by choosing me President, probably not so much upon me as upon the Michigan Fish Commission, and I assure you that every effort will be made to make the meeting at Milwaukee the red letter meeting in the history of this Society.

Mr. Clark: I would like to say that the President of this Society has something else to do besides preside at these meetings, and we expect the President to do something else besides post office business in the next year.

Mr. Bryant: In behalf of Wisconsin, I wish to thank you for the honor conferred upon that State by electing me as Vice-President, and I assure you that the office of Vice-President will not be regarded by me as a figure-head as it has been in the past. (Laughter.) My first step will be to issue a proclamation that you come to Wisconsin next year and we will assign you a brewery apiece in Milwaukee. (Laughter and applause.) We will show you that we are quite a wide-awake people.

The President: Before taking up the papers, we will re-

ceive applications for membership. We have some application cards here if anyone wants them.

Six names were then handed in and, on motion, the gentlemen were declared elected as members of the Society.

The President: Any further routine business or any unfinished business to be brought up at this time? If not, we will continue the reading of the papers. I have here a paper on the sturgeon, by Mr. Livingston Stone, who wrote me that he called it an apology for a paper. It is short and I think I will ask you kindly to give your attention.

The reading and discussion of the papers of Mr. Stone and Mr. Lamkin followed in order. Adjourned until after the trip to East Freetown.

On arrival of the Fish Hawk at New Bedford, a special car, provided through courtesy of Mr. Hurlbut, was found in waiting to convey the party to East Freetown and return. A very pleasant and instructitve hour was passed at East Freetown, inspecting Mr. Hurlbut's brook trout hatchery and fine stock of trout.

AFTERNOON SESSION, JULY 19.

On board the Fish Hawk, returning from New Bedford to Woods Hole.

Called to order by the President at 3:45. United States Senator Proctor, of Vermont, accompanied the members on the return trip and was duly elected a member of the Society. Mr. Thompson's paper was read and discussed, and the officers and crew of the Fish Hawk gave an interesting exhibition of deep sea sounding and dredging, after which the session adjourned until 8 p. m.

EVENING SESSION, JULY 19.

No papers were read nor business transacted at the

evening session, but the members were entertained in a most pleasing and instructive way by President Titcomb, who gave an illustrated lecture on fish culture and kindred subjects. About 100 slides were shown and fully explained, reproducing in enlarged form photographic views of the ova, in successive stages of development, of trout, salmon, whitefish and wall-eyed pike; the fish from infancy to full adult size; methods of taking and incubating the ova; various forms of hatching apparatus and utensils; interior and exterior views of hatching stations; ponds and raceways and natural spawning beds; and wild-life and landscape scenes from mountain, brook and forest. As the illustrated talk proved to be a novel and highly interesting exposition of the subject in hand, it is to be hoped that other scenes and views may be added to Mr. Titcomb's collection, for exhibition at future meetings.

Friday July 20, 1900.

On board steamer Fish Hawk bound for the Narragansett Bay and Providence River.

The President: The meeting will please come to order. I will inquire if the auditing committee have audited the account of the Treasurer and are ready to report?

Mr. Peabody: Your committee have examined the report of the Treasurer and find it correct as read.

The President: I do not suppose it is necessary to act on that report.

On motion it was ordered that all papers not received before the final adjournment should be considered as read by title and that they be printed in the report of the meeting.

Then followed in order the reading and discussion of Mr. Downing's paper; address of Mr. Morse; discussion on the care and feeding of brook trout, suggested by the trip to the East Freetown trout hatchery; and the reading of the papers of Mr. Stranahan and Prof. Mead.

On call of President Titcomb, the Committee on Resolutions submitted the following report:

REPORT OF COMMITTEE ON RESOLUTIONS.

Dr. Bushrod W. James: The Committee on Resolutions respectfully submits the following for your consideration and adoption:

Whereas, The Society has received unusual courtesies from the United States Fish Commissioner in the freedom for use of the residence and biological rooms at Woods Hole, Mass., and placing at the disposal of our President for the use of our Society all the resources of the station, together with the unstinted use of the vessels, the Fish Hawk and the Grampus, which have afforded the members of the Society not only great pleasure but extraordinary facilities for the transction of business. We desire to express our profound gratitude to the Hon. Geo.

M. Bowers for these favors which were made possible because of his broad and generous hospitality, feeling that the members of the Society present at this gathering will take away a lasting delight of this enjoyable meeting at Woods Hole in 1900.

2. Whereas, The success of this meeting of the American Fisheries Society has been largely due to the patient and untiring zeal of its valued President, we extend to him our heartiest appreciation of his energetic services and we extend to him a vote of thanks, and we likewise thank our most efficient Secretary and our careful Treasurer for their share in making this meeting a great success.

3. Resolved, That the thanks of the Society are also due Mr. Hurlburt, for the courtesies which have been extended to the members of the Society and their friends upon the visit to his Trout Hatchery, which was enjoyed by all.

4. Resolved, That the Society is not unmindful of the obligations due to the several officers of the United States Commission connected with this station for the many thoughtful courtesies received at their hands, and hereby make full acknowledgment of the same.

5. Resolved, That in the loss by death of our honorary member and most able and active worker in our Society, Mr. Fred Mather, as well as in the decease of Herschel Whitaker, another ardent, active member, as well as in the loss of Mr. E. P. Steers, and of Mr. A. Taylor, Jr., we feel deeply their removal from our earthly friendship and the severance of their relations that bound them to us in the active work in which our organization is engaged. And we request our Secretary to place a suitable minute in our transactions in memory of each and all of these deceased members.

BUSHROD W. JAMES,
GEORGE F. PEABODY,
H. W. DAVIS,
Committee on Resolutions.

On motion of Mr. Root, the report of the Committee on Resolutions was accepted and unanimously adopted.

Dr. James: In connection with this subject the thought occurred to me that it would be well for our deceased members to have a little more elaborate mention made of them, perhaps with a synopsis of their life-work and labors, and I think it will be well to have some one appointed to look after these matters during the year and sum them up. If agreeable, I would suggest that a necrologist be appointed to look after these matters. I trust none of the members will die, but I make the motion that some one be appointed as necrologist for the ensuing year.

Motion seconded and carried.

The President: I think no one is better fitted for that position than Dr. James, and I will appoint him.

On motion, Mr. Vinal N. Edwards was elected to membership in the Society.

The President: Is there any further unfinished business? Is there any new business to come before this meeting before we adjourn?

Dr. H. M. Smith: Mr. President, I desire to bring to the attention of the Society a matter which I believe will be favorably regarded by all the members, as well as by many other persons. It has seemed to me fitting that at this time and in this place provision should be made for a suitable memorial for one who most unselfishly and efficiently devoted his life to the cause of fish culture, the fisheries, and marine biology, and who more than anyone else was responsible for the magnificent establishment and work of the government at Woods Hole. Of course, no nobler or more appropriate monument could be erected to the memory of Prof. Baird than the one which already exists here; but it seems to me that simply as a matter of respect some memorial should here be set up to attest that American fish culturists and biologists are not unmindful of his distinguished services, and to show to the general public, more especially the coming generations, the connection of Prof. Baird with the fish cultural and scientific work here carried on.

It is to be regretted that at the capital city of the country, where for many years Prof. Baird was a leader in biological and general scientific research, as well as one of the best known and most highly respected citizens, no monument of any kind has been erected to the memory of this great and good man, who, to my mind, was just as much entitled to such an evidence of the nation's respect and gratitude as were the distinguished naval, military and political persons with the statues of whom Washington's parks and squares are filled.

Will it not be especially appropriate for this Society, which

so ably co-operated with Prof. Baird in securing the establishment by Congress of the National Fish Commission, to take the initiative in thus honoring his memory at a place which he conceived and developed, where he spent some of his happiest days and directed some of the most important work of the Commission, and where thirteen years ago he breathed his last?

For the purpose of bringing this matter formally before the Society, I have drawn up a set of resolutions, which I will now read.

Whereas, The American Fisheries Society, assembled at Woods Hole, Mass., regards as desirable and proper the erection of a tablet or monument to the memory of the late Professor Spencer F. Baird, in recognition of his distinguished labors in behalf of fish-culture, the fisheries, and biological science; and

Whereas, The Society deems it appropriate that this memorial should be located at Woods Hole, as a special tribute to his zeal in furthering the interests of marine biology and fish-culture; therefore,

Resolved, That a committee with full powers be appointed by the Chair to determine the most suitable form of the memorial, to raise the necessary funds, and to proceed with the erection of the monument; provided, that no financial liabilities be incurred on account of this Society without express permission.

Resolved, That the committee notify the surviving members of Professor Baird's family of the proposed action, and invite suggestions thereon.

Resolved, That a copy of these resolutions be transmitted to the United States Commissioner of Fish and Fisheries.

Mr. Clark: With the permission of the members of this Society may I have the privilege of moving that these resolutions be adopted. I know for one thing that I am one of the oldest men in point of service that commenced under Prof. Baird, and I am very much touched. I move the adoption of the resolutions.

Motion carried unanimously.

The President: I will take a little time to consider the names to be appointed and announce them later. Is there any further new business or unfinished business to be brought up at this time. The meeting will not adjourn now as we are liable to have business come up at any time. I am sure there will be one matter coming up at the clam bake; we will therefore simply suspend

our business for the present and take a recess until after the clam-bake.

AFTERNOON SESSION, JULY 20.

Convened at 3:45 p. m., Field's Point, R. I.

The President: Gentlemen, will you give your attention for a minute or two. I understand the Committee on Resolutions have a resolution to offer.

Dr. James, Chairman: I have a resolution to offer on behalf of the Committee.

Resolved, That the thanks of the Society are extended to Mr. Root and Mr. Willard and to the Rhode Island Fish Commission for their delightful and refreshing entertainment at Providence and the invitation to a Rhode Island clam-bake, thus giving a most enjoyable and novel treat to the members of the Society.

Mr. Dickerson: I want to make an amendment to the motion of Dr. James. I know that every member of the American Fisheries Society appreciates the courteous treatment they have had at the hands of everybody, and I want to speak especially for the western members, who heartily appreciate the courteous treatment received at the hands of the Commissioners, both of the United States and from the State of Rhode Island. I was just saying to my little girl that I have never had as enjoyable a time in my life as in the last four days. I want also to include the superintendent and the employees of the Commission. It seems to me that even the dock hands have gone out of their way to pay tribute to the members of this Society, and I think they and everybody connected with the Commission deserve our thanks and I therefore amend the motion of Dr. James, and move you, sir, that we extend a rising vote of thanks to the United States Commissioner and to the Commissioners of Rhode Island, and to the employees of the Commissions, for the consideration and courteous treatment we have received. (Applause.)

Dr. James: I want to accept the amendment of our new President.

Gen. Bryant, of Wisconsin: Mr. President, I beg to say one word in support of the resolution. This day has been one of very

pleasant experiences to all of us. It has added to my days one to be remembered as one of the grand feast days of my life. During the course of a not uneventful life I have been in many regions and tasted the viands so dear to the people there dwelling. I have eaten pumpkin pie in Vermont, johnny cake in New Hampshire, the baked beans and codfish balls of Massachusetts, tripe and sour kraut in the Mohawk valley, the capons of Pennsylvania, Smithfield hams in Virginia, terrapin in Maryland, corn pone and bacon in Georgia, and "possum" in Tennessee; I have fared on the best that grows in the fertile states of the west; partaken with relish of the scant fare of the soldier, the "hard tack and sowbelly," and the "Rappahannock stew," made by boiling bacon rinds with leeks and ham bones. I have eaten *boskamin-asagon paguegian* made by the squaws of the Chippewas, and tasted the "*pe-we-ta-gah,*" the crowning dish of a Winnebago feast, made by stewing pulverized dried venison in bear's oil and maple sugar. I have fooled away a good part of a month's pay in a swell dinner at Delmonico's, and thought I had tasted of about all the good victuals of this our bountiful union. But to-day, as the grand cap-sheaf of all, I have feasted to fullness at a clam-bake on Narragansett Bay. I had read of these in my boyhood as I had read of the ambrosia of mythology, and they left in my mind the dim impression of a half-formed dream. I had heard that Rhode Island clams, baked on the shore and with the drapery of the sea weed to cover them, were good, but I can now say with the Queen of Sheba, that the half had not been told me.

I know now, since we sailed up this beautiful bay, and since partaking of this feast, why we seldom see a Rhode Islander in the west. We have Maine Yankees, New Hampshire Yankees, Vermont Yankees, Massachusetts Yankees, Connecticut Yankees and Yankees in general thickly sprinkled through the west, and splendid state-builders they are; but we hardly ever see a Rhode Islander. I knew one of them once, and a good man he was, who lived a few years in a western city; but his heart so yearned for the sea shore and the clam-bake that he quit a good

business and returned to his native state. Later, he sent us a barrel of clams, but we couldn't find a longshoreman to show us how to cook them, and we failed to find the richness of the gift. No wonder the Rhode Islander clings to his native shores and his feasts upon the beach.

It was Tom Moore, I believe, who sang:

"Take the bright shell from its home by the lea
And wherever 'tis borne it will sing of the sea.
So take the fond heart from its home and its hearth,
'Twill sing of the loved to the ends of the earth."

And he might have added:

Take the Rhode Islander from his home by the Bay,
And wherever he goes you can't make him stay.

Let us congratulate our friends, the Rhode Island Commission, and her good citizens who have given us this occasion and graven on our memories a red letter day's pleasure, for their lovely homes and their happy lot; and let us thank them, in a heartier way than by mere formal resolution for their large-hearted hospitality, their kindly welcome and their daintiest of banquets—the clam-bake on Narragansett Bay. (Applause.)

The President: All in favor of this motion will please express it by a rising vote. The vote is unanimous.

Mr. Root: On behalf of the Rhode Island Commission I wish to say that we deem it an exceedingly great honor that the American Fisheries Society accepted our invitation here, and if you feel satisfied we shall feel exceedingly gratified. I can supplement all the remarks the gentlemen have made. I certainly enjoyed it all from the very first moment to the last. It was a business meeting and we have got our heads filled with new ideas, and practical ideas, and everybody will go away feeling and knowing that they have met a body of gentlemen that know their business. I thank you heartily, gentlemen, on behalf of our Commission for accepting our invitation. (Applause.)

The President: There was a little unfinished business. A committee was to be appointed to prepare for a monument

to the late Spencer F. Baird, of Woods Hole, Mass. The Chair will appoint as that committee the following:

COMMITTEE ON MONUMENT TO PROFESSOR SPENCER F. BAIRD.

Dr. H. M. Smith, Chairman.
Hon. Eugene G. Blackford.
Dr. E. W. Blatchford.
Hon. George M. Bowers.
Mr. Frank N. Clark.
Mr. Vinal N. Edwards.
Hon. George F. Peabody.
Hon. Redford Proctor.
Mr. W. de C. Ravenel.
Dr. Bushrod W. James.

And the Chair will take the liberty to authorize this committee to increase the list if deemed essential.

I will also suggest in connection with the membership list that a motion would be in order to authorize the President and Secretary of this Society for the ensuing year to add to the list of members elected at this meeting any applicants whom they deem eligible to join the Society, and who may present their names and pay their dues before the transactions of the Society are printed. Will you entertain this as a motion?

Mr. Dickerson: Is it your idea that your forthcoming President and Secretary shall decide whether such parties are eligible or not?

The President: Yes, sir.

Mr. Dickerson: And that any name approved by the President or Secretary before the proceedings are completed, will entitle them to membership?

The President: As of this year.

Mr. Dickerson: I desire to have the Society thoroughly understand the motion.

The President: I will say that last year the President and Secretary undertook to do that same thing. It seems to me if the meeting here authorize your President and Secretary this

year to do the same thing there will be a number of members come in and pay their dues at this time.

Mr. Davis: I think we ought to consider that motion very carefully before we act upon it. Owing to the offer of General Bryant we expect that a small army will go to Milwaukee; as we have the offer of a brewery apiece over there I think the whole population of Grand Rapids will turn out and go to Milwaukee. (Laughter.)

The President: The Chair takes it to be the motion as seconded that the incoming President and Secretary are authorized to add to the list of members, such names as are presented, with their dues, before the transactions are printed, and will print their names as members of this Society for this year.

Motion carried.

Dr. Bumpus handed in the names of six candidates for membership and, on motion, the gentlemen were declared elected.

The President: Is there any further business before this Society?

Dr. James: I move that we adjourn sine die.

Motion seconded and carried.

Adjourned at 4 p. m. at Fields Point, R. I., July 20, 1900.

Deceased Members Since Last Annual Meeting.

✠

Fred Mather

Herschel Whitaker

A. Taylor, Jr.

E. P. Steers

S. W. Milbank

PART II

PAPERS AND DISCUSSIONS

EXHIBITION OF "ORIGINAL CONTRIVANCES" FOR USE AT BROOK TROUT HATCHERIES; WITH DESCRIPTION AND DISCUSSION.

By C. C. WOOD, Plymouth, Mass.

Gentlemen: I have not prepared any paper at all on this subject; I just wish to show you some "Original Contrivances." If anyone has anything better I should be very glad to know it now.

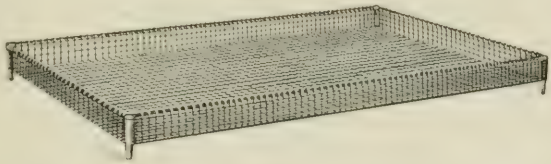

FIG. 1

This is a hatching tray (Fig. 1), that we use over in Plymouth, made entirely of wire. It is raised up from the bottom of the hatching trough by a little wire leg at each corner, so. When it is placed in the trough there is a circulation of water underneath, as well as over, and being all wire it gives more room for the eggs, and then there is no wooden edge to collect slime or fungus.

Mr. Clark: As he goes along are we going to ask questions? If so, I would like to ask a question on the tray now. Do we understand that you use that tray for hatching the eggs?

Mr. Wood: Yes, sir.

Mr. Clark: I would like also to ask Mr. Wood how many trout he handles?

Mr. Wood: About 700,000. We put on that tray, say 10,000 eggs, and the eggs are left there until hatched.

Mr. Davis: Do you think it would improve it to have an oblong mesh?

Mr. Wood: Not at all.

The President: Mr. Wood, do I understand that the fry drop through this wire tray just as they do through the oblong?

Mr. Wood: Yes, without trouble.

The President: Is this galvanized iron cloth?

Mr. Wood: Galvanized and painted two coats.

The President: Do you find the galvanized iron cloth is cheaper in the end?

Mr. Wood: Yes, more durable. If anyone is thinking of getting trays like this I would suggest they have the wire cloth made flat, as if taken from a roll it is difficult to make the trays perfectly flat on the bottom.

The President: What is the comparative cost of this tray over the wooden tray?

Mr. Wood: As we find it, it is cheaper, but galvanized iron unless painted will kill the eggs.

Mr. Ravenel: Why do you say that galvanized iron will kill the eggs; have you ever tried it?

Mr. Wood: Yes, sir; we find that the galvanized iron where the egg is laid on the tray will kill the egg.

Mr. Ravenel: Fish are carried in galvanized iron tanks with safety.

Mr. Clark: I would say that we have probably 400 trays made of galvanized zinc, and there is not a particle of paint on them, and the trout eggs are handled on those the same as those having paint. They have been used for four seasons and we have them in use now.

Mr. Wood: Do you use them for green eggs?

Mr. Clark: Green eggs, and until the sacs are gone, when they are taken from the trays and distributed.

The President: Mr. Clark, I would inquire if you use this kind of mesh?

Mr. Clark: No, sir, the size of the mesh is always governed by the size of the fish. Our experience and our plan at the Northville Station is always to hold the fish on the tray until the sac is gone.

The President: That is in the Clark Hatching Box?

Mr. Clark: Yes, and the Clark-Williamson, too. We do not remove them from the tray they are on; they are left until after the sac is gone, until distribution.

The President: I would like to inquire of Mr. Wood if he sees any advantage in this over the oblong mesh?

Mr. Wood: I have not used the oblong. This seems to answer the purpose very well indeed.

The President: You stack those trays one upon another?

Mr. Wood: Oh, no. I find I can hatch as many trout eggs on that tray as it will do to keep on a hatching tray.

Mr. Clark: We hatch 40,000 fry and it doesn't take as much space as you have there. In one box we hold the whole 40,000 fry until they are ready to distribute.

Mr. Wood: At what age are they distributed?

Mr. Clark: When the sac is gone. If we did not hold them in some such compact way as that, I don't know how we could handle from 5 to 10 and 15 million trout eggs in an ordinary hatchery.

Mr. Wood: I would like to say in all the Eastern hatcheries the plan has been to use the single tray system. I have never seen any other, and we, in our hatchery, seldom sell any fry before they have been feeding at least six weeks. We hatch out 100,000 fry in a space 20 feet long and one foot wide, and they run pretty thick. We always feed our fish before putting them out; in fact, people won't buy them unless we do so.

The President: Your fish hatch in mid-winter?

Mr. Wood: Usually about the first of January.

The President: Is there any further discussion about the tray?

Mr. Ravenel: It is the same kind that Mr. Buck made; practically the same tray. I had a sample sent to my office, but it was all iron.

Mr. Wood: How long ago?

Mr. Ravenel: About a year ago.

Mr. Wood: We have used this kind of tray five years.

As we feed all our fry, we found it considerable trouble to take care of several hundred thousand trout fry when we feed them. After fooling around a good deal I got up something of

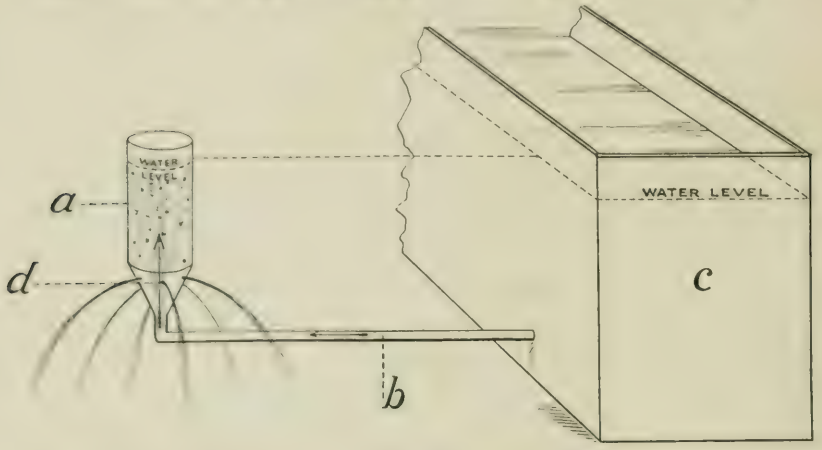

Fig. 2

Fig. 3

this kind (Figs. 2 and 3). During the first month of feeding we find it a great help. Around this feeder are six holes—three on this side and three on this side here. We connect it with the supply pipe in this manner; that screws right under there. We set that between the two boxes. It sets like that. I will take this piece of paper to illustrate the box. This pipe here is connected with the supply reservoir; we regulate the supply of water which comes in here up through the center until the cup is almost full. The current keeps the water agitated and also the food, and it is some little time before the particles of food find those little holes and go out, and when they do, they go with a nice little current, and the trout fry will go for them eagerly. We put three of these double feeders on a box, and in feeding them we go along with a quantity of food, taking it up with a syringe and putting a little in each box. The little fry cluster around by the thousands at feeding time and hustle for the food. It is simple, and I have never seen anything like it before. We like it very much and have used it for five years.

The President: I would inquire of Mr. Wood if he would use that for aerating purposes only?

Mr. Wood: I would if the water supply was small. It depends on what water supply you have. We raise a good many fry, considering the space and on a little water.

Mr. Ravenel: What is your water supply?

Mr. Wood: The total water supply? I can't tell you exactly; somewhere about 300 gallons a minute.

The President: For the hatching house?

Mr. Wood: No; for the whole plant.

Mr. Clark: How many fish have you on hand?

Mr. Wood: At the present time we have sold something over two tons of market fish. We have on hand about 10,000 year old, 7,000 two years old and 250,000 fry. We have a hatching house in which we can handle three million eggs at the Nook hatchery, which we take about every season.

Mr. Thompson: I would like to ask if he gets his total water supply through there?

Mr. Wood: We have a faucet over the trough that supplies us with the hatching water, as we don't use these at all during the hatching.

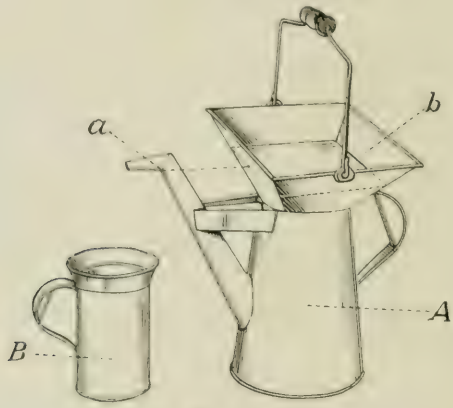

FIG. 4

Now, in selling trout fry, we have customers who are often very particular to get the exact number (it does not matter whether they are selling at $1.50 or $3), and I always like to have a customer that way. I wish every customer would count his purchase. It bothered me a great deal to count the fry, and I rigged up something of this kind (Fig. 4), which is much better than a dry measure and a tin dipper, and we use it in this manner: I set it on the bench and fill it with water, and I put the measure under here, and I count out a thousand fry or two thousand; perhaps five thousand—of course putting those in a pool by themselves; then take those out with a net and put them in here and measure the water which they displace. Now, it does not matter whether I take one-half or just a few at a time; if I find 5,000 in there displaces one-half pint of water, why, I think it is pretty fair to judge that half a pint of water displaced is a fair estimate for 5,000 fry.

The President: Any inquiries about the measure?

Mr. Ravenel: I will say, for Mr. Wood's information, that at a great many hatcheries, where they have to count fry, they do it by weight. They count out a thousand and put the fish in the scales and weigh them, and then simply go on repeating in that way, adding so much water and so many fish.

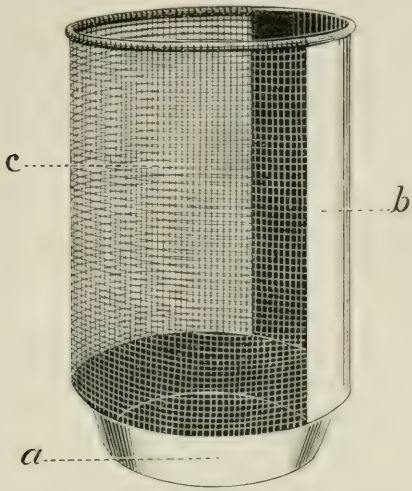

FIG. 5

Mr. Wood: When we make a shipment of trout, sending out 20 or 30 cans, we often have to turn out very early in the morning, and I thought of something so we could get the trout ready the day before. This does not look like much of a rigging (Fig. 5), but I had to think over it for quite a while for all that. It is better than a square box for this reason: We put this in a pool and count the fish in here, whatever number we want, 100 or 1,000. In the morning we have our cans ready, our express team comes and we pull these out of the water and empty out the fish. This pan holds some water, enough to lubricate the fish, so to speak. The tin here keeps them from getting scraped on the wire cloth. We take them out and pour the fish into the can, and sufficient water goes with them to prevent injury.

Mr. Clark: I suppose that is for shipping just one or two cans?

Mr. Wood: Oh, no; forty or 50 cans; or one hundred, if necessary.

Mr. Clark: And you would use those for forty or fifty or one hundred?

Mr. Wood: Certainly.

Mr. Clark: And the object is to save time in the morning?

Mr. Wood: Yes, sir.

Mr. Clark: Mr. President, I want to state here that we loaded from our fish hatchery, since the 1st of July, 100 cans in 45 minutes, taking the fingerlings from the tank where they were held, and they were weighed up accurately; cans filled with water and fish put in them in 45 minutes.

Mr. Wood: How much help do you have?

Mr. Clark: Six men.

Mr. Wood: We have no men; I can do it myself. I would like to ask Mr. Clark how many yearlings he puts in a can?

Mr. Clark: Do you mean fish that are actually a year old?

Mr. Wood: Oh, no.

Mr. Clark: We don't distribute many fish after a year old.

Mr. Wood: Then, perhaps, you mean fingerlings. What was the number of cans?

Mr. Clark: One hundred cans in 45 minutes.

Mr. Wood: What month?

Mr. Clark: This was a few weeks ago.

Mr. Wood: How many would you put in a can?

Mr. Clark: Well, I can't tell you whether 650 or 700. Of course every time a car comes in we have to count and weigh again in order to get our standard.

Mr. Wood: What size fish?

Mr. Clark: Well, two and a half to three inches.

Mr. Wood: Our fry will average about two inches long. I usually put about 1,500 in a can, and we have found this a great help in saving time, because we have to count them in the morning unless we use this.

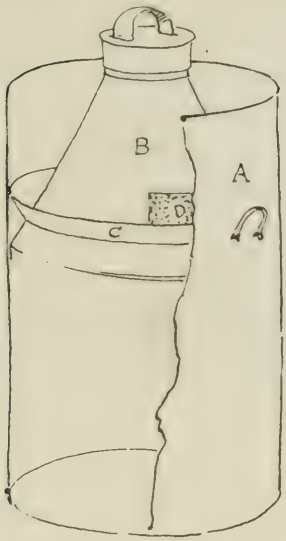

FIG. 6

The cans which we use for shipping purposes are something like this can here (Fig. 6); an ordinary ash barrel, and we fit into that a solid conical top here, about the center of the can. A little way up we put in a tin strip. That is done because occasionally in dipping them a trout will get out on the side, and it is easier to remove them from the tin strip than if it were not there. Around the circumference here are pieces of perforated tin. We fill the can with water and pack ice around the top of it. The ice, as it melts, trickles through the perforated tin, which answers every purpose of a refrigerator can, with the additional convenience that we can get at our fish without trouble. I have been with twenty of those cans on a long journey, taking 1,500 fish to a can, and would like to have an opportunity of going on a long journey with another load, if I can get an order after this meeting.

The President: I would ask first if there are any inquiries about his arrangement for keeping the fish over night? Any questions about the can?

Mr. Nevin: I think the can is very nicely arranged for shipping fish a short distance.

The President: What do you use, Mr. Nevin?

Mr. Nevin: An ordinary milk can.

Mr. Wood: I would say that the express companies usually charge us for about everything they can, and additional ice is sometimes charged for.

Mr. Bennett: I would like to ask how he disposes of the water after it gets stale?

Mr. Wood: Take it out with a dipper.

Mr. Bennett: Over in here we put a cap with a perforated wire on, and after this gets full here we unscrew this cap and the water will run out.

Mr. Wood: I think that any outside arrangement like that the express companies will surely knock off in handling, and that is why there is no cover to this can for they get lost; and now when they take a wagon load of trout over the pavements without covers, the express fellows are pretty sure to get wet, and it serves them right, too, I think.

The President: What price do you give for your cans, Mr. Bennett?

Mr. Bennett: I pay $4.50 each, and I get the cans of the Iron Clad Manufacturing Co., of New York.

Mr. Wood: Quite often we take a dipper full of water and throw it out of the car as we go along, and I would never go on a trip without a dipper.

Mr. Handy: I would like to ask Mr. Wood if that is white paint?

Mr. Wood: I am glad you asked that. I have always wanted my cans painted white and I never dared paint them with white lead. I wrote to the superintendent of the hatchery at Cold Springs Harbor, L. I., a short time ago, and asked him what he used, and he told me they were in the habit of painting their cans with white paint, but before he answered my letter I had already got some paint, and this is the can I painted. You mix the paint up with water and a little oil. I sent a load of fish

up into Vermont a while ago that went from Boston, and were gone six hours without any attendant, and the man reported they arrived in good shape, so I went to work and painted all my cans with it. I get the paint of Nash, Winslow & Co., of Boston; they are well known dealers. It is what is called "aquol" paint.

The President: What does it cost?

Mr. Wood: It costs 10 cents a pound in 10-pound lots.

The Secretary: I would like to ask Mr. Wood whether he has ever steamed his cans since he used that paint? It is a question whether they would stand steaming or not. We find it necessary to steam our cans occasionally to keep them clean and free from "fishy" odors, particularly in warm weather.

Mr. Wood: I never tried it. We always wash our cans though, thoroughly.

The President: Any further inquiries about the can?

Mr. Bryant: When you deliver a considerable quantity, you get them through safe?

Mr. Wood: We guarantee delivery with attendant; still we sometimes send them from Boston to St. Johnsbury safely alone.

The President: About five hours?

Mr. Wood: Yes, I should judge so. You are a better judge than I. We can send them from Boston to New York City; the swash of the water while on the train helping to keep them alive. I know there are refrigerator cans which some think are just as good as these, yet in carrying trout I never like to make the water any colder than necessary. I wouldn't take the fry from our hatchery, where the water is 52, and cool it down to 35 and expect them to live under ordinary conditions afterward. I remember at one time I took a lot of trout, and there was a difference in the temperature of 8 degrees only; the water we had put them in was 8 degrees warmer. I was in a hurry and dumped the trout out, and the man wrote me that he picked up several hundred dead trout the next day.

The President: I think Mr. Hurlbut ought to tell us a little about his can.

Mr. Hurlburt: I wish to say here that we ship everything

from Freetown right through to Vermont, starting about 4:30 in the morning. We load them up and get them over to the depot between 4 and 5, most of our shipments, and we have had no trouble so far. We send them by express without any messenger. I should disagree with Mr. Wood regarding temperature. Of course we have our different experiences. I don't think you can have water too cool for trout, providing you cool the water slowly and keep it cool until you get to your destination; then remove the ice box from the can, and dip water from stream to raise temperature of water gradually, letting them stand five to ten minutes, and turn them into the stream, and you have no trouble and no losses in shipment.

The President: What can do you use, Mr. Hurlburt?

Mr. Hurlburt: I use the S. E. Land refrigerator can; nothing else.

The President: I will say in reference to the temperature of

Fig. 7

water, it has been my experience that you cannot get the water too cold for an all-day shipment, but you can kill your trout by giving them a sudden change. You can kill all of your trout very quickly, and I think if we who raise trout could plant them, or have our experts plant them instead of having Tom, Dick and Harry receive them at the train and dump them, that in many instances we would get much better results. Is there anything further about the can?

Mr. Wood: Now, this next rigging is the last (Fig. 7). In carrying a lot of trout and a lot of cans, as I said before, I would have a dipper, but I find this arrangement is a great help, and you can see how it works. We put that tube with one hole through the end into the can. If the hole is too large, it doesn't work nicely, because all the air can get out of one or two tubes; when if the hole is small it will act in this manner, in the manner of a blow pipe. We put this tube in here, which will go, perhaps, six inches under the water. If allowed to go too far down, sometimes the fish will be thrown against it and injured. We put another one of these tubes on this side of the pipe and put another can here, and we can connect about a dozen cans in this manner to one blower; and then, after we have once arranged the cans, all we have to do is to keep our foot going, and you can keep trout alive with this arrangement, the can perfectly still, for eighteen hours without changing the water, as I have done with 200 fish four inches long in one of these cans. Of course we had to do considerable pumping along the last few hours.

Mr. Ravenel: That was a hatching house experiment?

Mr. Wood: Yes, sir. It is a great help when you have lots of fish to carry. This blower works better than a bellows, because the rubber reservoir gives a constant stream of air. With a pump it don't seem to work very well. I have worked these cans in express cars when everything has been crowded up—when we couldn't get between the cans; but had to climb over the first cans to look at No. 12 up in the corner. I think that is all, gentlemen, I have to say. I am sorry you are not coming to

Plymouth, but you will see, perhaps, some of these arrangements at Mr. Hurlburt's.

Mr. Davis: I would like to ask Mr. Wood if it isn't a fact that ice will take largely the place of air in your cans?

Mr. Wood: It would by lowering the temperature of the water.

Mr. Davis: Wouldn't it be better for the trout, rather than to let the temperature rise, to use ice and not your pump?

Mr. Wood: I don't think so.

Mr. Davis: I understand you don't use the blower if you use ice?

Mr. Wood: Yes, we do. I never get the temperature of the water any lower than I think is absolutely necessary, and that is perhaps about 47 or 48.

Mr. Davis: Don't carry them any lower?

Mr. Wood: No, sir.

Mr. Davis: I have great faith in ice. Some two years ago we went out bass fishing on the Kalamazoo river. At the little place near where we caught our fish we couldn't get any ice. We loaded the fish into barrels and did what we could on the way. Before we arrived at Kalamazoo, where the ice was, every black bass was at the top of the barrel on his back, and we had men with pails and dippers changing the water. We had telegraphed ahead for ice, and the moment we began using it the fish began to recover. We put in a piece as big as a pail. The fish had been carried in water of probably 75 degrees. We kept a big chunk of ice in the barrels until we reached Grand Rapids, and the fish all revived soon after we put the ice in.

Mr. Wood: That was bass. I am speaking only about trout. I never carried any other fish, but I should think, everything considered, that it was best in most cases to keep the water about the same temperature that the fish have been living in, and I do it to prevent the sudden changes which, if we arrive at night, might be almost impossible to prevent when putting the fish out; but if everything else failed, I would not hesitate to put ice in, even if we got the temperature very low.

Mr. O'Malley: I would like to ask Mr. Wood—you spoke of keeping fish alive eighteen hours—did you use ice at the same time?

Mr. Wood: Yes, to keep the water at an even temperature.

The President: About what temperature?

Mr. Wood: About 47 or 48.

The President: If you had that can aboard a baggage car and people smoking cigars, etc., around there, and pumping that air into those fish, do you think it would be as good for them as to keep the water at a much lower temperature with ice?

Mr. Wood: I have never seen any ill effects, and then I always think the air at the bottom of the cars is better than at the height we are breathing; better than anyone would think unless they got down and tried it.

The President: Are there any further questions? Have you any cuts of any of these?

Mr. Wood: I have a cut of the can and little feeder. I have no cuts of the other apparatus, but intend to have them.

The President: So that we could use them in illustrating.

Mr. Wood: I would be pleased to supply them to you.

The President: I want to say a word about transportation. We have different methods in Vermont. We have the old-fashioned can, that is about as large as this, and then comes up narrower and opens up in the top, with a strainer in it. It takes up a good deal of room and is clumsy. Then we have the ordinary 10-gallon round-shouldered can for shipments of from 3 to 10 hours. We get along very nicely with that if we send a messenger. After we have cooled the water in the can we invert the cover and fill the cover with ice, and we find that with the ordinary swashing on the baggage cars that the little piece of ice in the cover on top is about all that is necessary, and we don't work over the fish at all unless they stand at the station fifteen or twenty minutes. We keep our temperature right down, anywhere from 34 to 36 degrees.

Mr. Wood: Your shipments do not require fish to be kept so very long in the can.

The President: Not over eight or ten hours; an average shipment is about six hours. Then we have shipped in the Land patent can. All railroads transfer our messengers and our fish free, but in making our shipments it takes more help than the State will warrant. We use the Land patent cans, put them on board in charge of the baggage master, and sometimes they change cars at three or four junctions to get around the State. We do not hesitate to ship in that patent can in baggage cars for trips of six to ten hours without any messenger whatever, and we have never lost a fish.

Mr. Ravenel: We have sent rainbow trout through the south in the fall, temperature about 52, with practically no loss.

The President: You don't put the temperature down as low on rainbow trout as speckled trout?

Mr. Ravenel: No.

The President: We sent out this spring shipments of trout for the United States Fish Commission that started at midnight and were on the road all the next day until the next afternoon about 4 o'clock. My messenger took care of them all that time without loss during the trip.

Mr. Clark: It seems to me that great stress is laid upon the use of ice around the can, but nothing has been said about putting the ice in the can where the fish are. I don't have much practical experience in carrying fish now, but I used to. I have used ice in the cans with the fish for twenty-five years, and there is no objection to it. If your fish are in good condition and well taken care of, and all right, they will get down below the ice and stay there, so that your ice may just as well go in the water. The can that Mr. Wood has is something similar to what has been tried before, and is a good thing, but there is certainly no objection to having your ice in the water. You all lay great stress in having your ice melting and the water dripping in and not coming in contact with the fish.

Mr. Wood: We never hesitate to put a piece of ice in the can when necessary, but in starting if we put all the ice in the

can it will only lower the temperature for the time being. If you wish to put a piece of ice in, take a piece up occasionally and put it in, then if we get an additional supply at a station, it is put in around the top and we get the benefit of the ice as it melts, because all that melts helps keep the water cool. Besides it is very handy, and although one piece of ice may not injure the fish, yet by putting in a whole lot of ice at first and putting them on a truck and carrying them to the depot, some of the fish are liable to get hurt, if in the best possible condition.

In regard to the transportation of trout, it is of course to our interest to carry as many as we can, even if the customer pays for transportation, for it costs him enough in any event. I have recently been with trout fry for twenty-four hours, giving them constant attention, and I would say that the labor required depends much on the number of fish you have in a can. While on some of my trips I frequently meet many of the Government or State officials, and I must say that these gentlemen always care for their fish with about one-quarter the attention that I find mine require.

Mr. Clark: I am afraid people will infer from what has been said that we pitch a half a ton of ice into a single can. We simply give a can of fish the necessary amount of ice to keep the temperature down to the desired point; the rest of the ice is taken care of in extra cans, but we do not fill the cans containing fish solid with ice; simply use what is necessary.

The President: You will excuse the Chair for saying any more on this subject, but my line is trout work. The same idea that he obtained is what I brought up about this round shoulder can, about using the inverted cover. If you have to save ice there is a drip from that cover into the water, and I have an idea it will act as an aerator. Of course, we carry other fish than brook trout, but if you take the rainbow trout you can't have them so cold, and if you take the steelhead trout, you can't have them so cold. A lake trout will stand just about as much ice as a brook trout, won't they? I like the idea of using some can with a cover

that way; I think you will find it a very nice way of handling your fish.

Mr. Wood: Excuse me, do you get the same advantage as this with no cover full of ice to lift, when you wish to look into the can?

The President: Oh, yes. Your cover is right up where you can easily glance in

Mr. Bryant: What does that can cost, of the same capacity as a milk can?

Mr. Wood: I can't tell you. These are made from the ordinary ash barrel, and they cost us $4 apiece.

The President: What is the shipping weight of that can, loaded with fish?

Mr. Wood: 150 pounds.

The President: Anything further on the can,—on Mr. Wood's talk? If not, we will now have Mr. Brewster's paper.

THE RELATION OF THE FISH AND GAME WARDEN IN THE WORK OF FISH PROPAGATION.

BY C. E. BREWSTER, GRAND RAPIDS, MICH.

The rapid depletion of our waters of its food fishes by reason of the vast increase both in the number of men engaged in fishing and the number of nets used, has made it necessary for the enactment of laws for the artificial propagation of the desirable kinds of fishes to re-stock our lakes and streams.

This work has usually been placed in the hands of State Boards of Fish Commissioners. Their duties are the taking of spawn, the hatching of the eggs, the apportioning of the fry to the various waters, and superintending the depositing of same.

In my own State of Michigan, with her more than two thousand miles of coast line bordering the "Great Unsalted Seas," with her thousands of inland lakes and streams all teeming with fish, the question of either protection or perpetuation did not present itself to the earlier citizen. Whitefish and trout were abundant in the Great Lakes, and every settlement near enough to the coast to do so had a few nets, usually owned in common, and used for the purpose of taking fish for their own use only.

In the coast towns a few men had nets and made fishing their business. The nets were of large mesh, and the fish taken were necessarily so. Sail boats only were used, and three men could handle two gangs of gill-nets, possibly three miles long,—one gang only being in the water at a time.

But with the rapid increase in population, conditions changed. Factories and manufacturing plants were built to utilize the product of our forests. Sawdust and slabs were dumped into the waters without protest. This offal, as it became saturated, sank and shifted around on the bottom, driving out the whitefish. Fishermen cleaned their fish on board their boats, dumping their offal into the lake.

And then came the tug fishermen. And with the advent of the tugs came a marked increase in the number of nets used. Methods of handling nets and fish have been improved. Steam lifting apparatus has taken the place of men, and it is now possible to lift nets on a single tug at the rate of four miles an hour, and it is not an unusual thing for fishermen to set a single gang of nets fifteen miles in length.

John O'Neil, a prominent commercial fisherman at Charlevoix, informed me that upon the 29th day of last October (the last day of the open season) he had seventy-five miles of gill-nets in the water.

But to return to the sawdust and offal matter: It became apparent in the course of time that the fish supply in the Great Lakes was decreasing, and in 1865 the Legislature passed an act making it unlawful to "put into any of the waters of this State where fish were taken, any offal, blood, putrid fish, or filth of any description," and imposing a penalty of $300.00 for its violation.

Special acts were also passed regulating the manner of taking fish in the inland lakes in some of the counties. In 1871 the first general fish law was passed. It regulated the manner of taking fish, both in the Great Lakes and in the inland waters.

Still the depletion continued, and in 1873 a law was enacted "to establish a Board of Commissioners to increase the product of the fisheries, and to make an appropriation therefor." This act appropriated $7,500.00 for the use of the Commission for each of the years 1873 and 1874 to cover all expenses, both the building of a hatchery and the necessary expenses of the Commission, and it was their duty "to supervise generally the fishing interests, and secure the enforcement of all the laws relating to the protection of fish and fisheries in the State."

No compensation has ever been allowed any member of the Board. They have served the State absolutely without pay. Uniformly men of broad gauge and thoroughly in love with their work, they have served the State faithfully and well, and the perfectly appointed hatcheries, with their beautiful buildings, the in-

land lakes and streams re-populated with the most desirable kinds of fish, stand as a perpetual monument to the earnest, intelligent work of the Michigan Fish Commission.

They have stocked our streams with trout and other game fishes, our lakes with bass, pike, perch, and lake trout. *They have also given us the German carp.* But in spite of the enactment of all these laws, the results were not entirely satisfactory. They were not enforced. Local officers winked at the most flagrant and open violations. The commercial fishermen used small mesh nets, and in the inland lakes and streams, spears, dynamite, and nets were used without danger of prosecution.

In 1887 the present president of the National Sportsmen's Association, Hon. A. L. Lakey, of Kalamazoo, introduced a bill "To provide for the appointment of a game and fish warden." Mr. Lakey had accepted the nomination and came to the Legislature for the sole purpose of revising the fish and game laws, and provide for their enforcement. He met with a most determined opposition, but succeeded in getting his bill through both houses, and it was approved by the governor, March 15, 1887.

The term of office of the State Warden is four years. A brief comparison of the conditions existing before the appointment of a Warden may be interesting. During the entire four years preceding the appointment of a State Warden, there was a total of fifty-six convictions in the State. During the four years' administration of Hon. William Alden Smith, the first Michigan Warden, 494 convictions were secured. During the year just closed—being the first year of the administration of the Hon. Grant M. Morse—867 cases were handled, with a total loss of only eighteen by acquittal. More than $20,000 worth of nets and fishing appliances were found in illegal use, seized and condemned.

Thus is the work of the Fish Commissioners supplemented and aided by that of the Warden. It has been said: "He is indeed a public benefactor who causes two blades of grass to grow where but one grew before."

The Fish Commissioners of Michigan have accomplished more than this. They have increased the product of our inland

waters a thousand fold; our lakes are being carefully stocked; our streams are already full. The stocking of our Great Lakes with the rapid growing trout and the peerless whitefish is being systematically carried on. (They have seen the error of their ways and have abandoned the propagation of carp.)

Their work is beyond praise and the results obtained will forever remain commemorative of a philanthropic work well done, a stewardship faithfully kept.

And side by side with the encomiums passed upon the Fish Commissioners, will go forth the thanks of a grateful State for the forceful and splendid work of her State Game and Fish Wardens.

DISCUSSION OF MR. BREWSTER'S PAPER.

Mr. Ravenel: I take exceptions to every one of those reflections on the carp. Some private citizen in California introduced the carp, and I am very sorry that I did not look up the figures before I left; but I am under the impression that the introduction of the carp into various countries has been of more value to mankind than any other fish I know of. The catch is between fifteen and nineteen million pounds in this country, but the value I do not know. Carp are worth as much as bass in Illinois; in Philadelphia they are worth more than shad; of New York it is unnecessary to speak. I will say that they never bring less than 12½ cents a pound, whereas cod is sold at 6 cents. I believe to-day the prejudice against carp has practically disappeared, though in New Jersey it is a penal offense to plant carp in the waters of the state. In New York they sell millions of pounds, and it brings more than red snapper and shad. At one time last fall on the Illinois River millions of pounds of carp were being held by the fishermen for the market. The angler is largely responsible for the prejudice against the carp. He asserted several years ago that it ran out all other fishes. Two years ago we seined the canal that empties into the Potomac River near Washington, and we kept accurate account of the fish caught. We caught between 5,000 and 10,000 black bass

and only a few carp, and those were all large ones; we could not find any small carp. They said carp were there by the millions, but where had they gone? The bass had increased, but there was scarcely a young carp in the canal.

Mr. Davis: I have no statistics here, but I remember in regard to the value of carp caught in Lake Erie more than a year ago. Mr. Fred Dewey said that carp were a nuisance, that they caught them in their nets, and couldn't get any price for them; that they carried them out in the fields and buried them, and got rid of them the best they could. If they are worth so much more than black bass and whitefish the fishermen there should be notified that they are losing a good deal of money. I saw a while ago a piece in the paper about the carp driving out the black bass, and I understand the State of Minnesota was sued by somebody because the carp got onto somebody's meadow.

Mr. Dickerson: That was a suit begun against the United States Fish Commission. (Laughter.)

Mr. Ravenel: As far as the carp is concerned I would like to say that Mr. Davis can write to Dr. Bartlett and find out their value.

Mr. Dickerson: I go up to the Lake St. Clair "Flats" three or four times a week. In the shallow bays there, which are carp feeding grounds, bass have increased very rapidly in the past three years, and yet about every man I meet says, "Dickerson, I wish you could destroy these carp." Now the fact is, I think the carp is a benefit to the bass in those waters. Another thing, the carp does not thrive in the clean water that the bass does, and I really believe that the carp in a section like that is a benefit to the bass, as the young carp furnish a great deal of food for the bass.

Mr. Davis: Isn't it a fact that the carp is a great spawn eater?

Mr. Ravenel: I wish I had Dr. Smith here. I do not believe that the carp is any worse than many other fish in that respect; nearly all fish eat spawn.

Dr. James: I remember some years ago, at the time when the carp was in its glory, everybody was putting carp in their streams. They were a rapidly growing fish, and a large fish, and had some value in the way of food. I watched some of the carp in a pond and stream on a farm I had along a large stream, the Rancocas creek, New Jersey. I put them in from two or three distributions before I succeeded in growing on account of local enemies in the ponds, and about all the people around that neighborhood who had streams of water planted them with carp. I studied up the subject pretty thoroughly and I found that these carp were great spawn-eaters. It was said that they ate nothing but vegetable food. I read a paper on this subject, stating that they were great fish spawn eaters, and would eat out the streams of their own spawn besides others, and I was laughed at because I deviated from the view that they were anything else but a vegetable eating fish. Well, that was at my expense, and now almost everybody, with the exception of a limited few, are against the carp. Who brought the original German carp here I don't know, but the United States Fish Commission had them and furnished them to us in large amounts, and I sent quite a large number of them up through New Jersey, and the Commission furnished many persons with them at that time when they were popular. That is my experience with regard to the carp. They do eat material to-day affecting the fibre, very much like the shad, which oftentimes become contaminated coming up the Delaware River, where there are a great many tanks of petroleum on its banks. Now, when the shad that are caught as they come from the ocean at the Delaware breakwater, down at Cape May—they lay around there for a while—those shad that come into the market are simply luscious. These shad come up the first of the season, before they get up to the polluted waters of the larger cities like Wilmington and Philadelphia, and there others become contaminated to a certain extent as they lay in waters receiving the sewage from the cities. I have thrown them off of my table on account of the petroleum taste, and I have also tasted the mud and sewage of the city in their fibre.

Our laws in Pennsylvania are food-fish protective. We have two of the larger streams running through the state, the Delaware and Susquehanna. Twelve or fifteen years ago, about fifteen perhaps, the value of the shad caught in the Delaware River was about $75 annually, that is about the entire valuation of the shad that were sold; but by having the laws arranged so as to have a closed season, and by the system of hatcheries—we have a fine shad hatchery in Bristol where we propagated about ten millions of eggs this year—the income is now between $700,000 and $900,000, very nearly a million dollars from shad alone and $43,000 from salmon.

The President: That is shad?

Dr. James: Yes, shad alone. Now that is simply to show how the laws can be made for one fish or for another or for all. I think by the laws of Pennsylvania we do not now plant any carp at all, but with brook trout and rainbow trout we fill the trout streams every year. About three years ago the legislature cut off our appropriation, but the year before we planted 105,000,000 of different kinds of fish, shad, bass and brook trout and all the varieties of good fish in the waters of Pennsylvania, and it just cost about $35,000. Last year they were going to cut the appropriation down to about $15,000. I happened to be up at the legislature at the last meeting and I plead with them to give us at least $35,000, and I said the income of that $35,000 will bring your state in nearly a million in the propagation of shad alone, and it is not so much the valuation of the fish as the amount of good food it gives our people. It is said here that the carp are more valuable than the shad. Why? Because we have so arranged as to the matter of hatching that there is such a great quantity of shad thrown on the market that the value goes away down, and the man who sells them does not want it down below a certain price, but the people do. We can feed thousands and thousands more people upon shad; it is very good food, but the value is kept up by those who catch them, and there the poor and rich come in contact as to the supply of food. We know that fish is on the menu of every hotel, and is one of the important

features of home meals, and we ought to keep the valuation down for the benefit of the masses of people. And for all these valuable food fish, like the shad, trout and bass, which our protective association, which I represent, is making efforts to have good laws enacted to protect from being seined out and is what we have been working for a great many years. Maryland occupies a large section for quite a number of miles across the Susquehanna River, and they allow fishing the entire year and they keep the upper streams from being filled with the spawn of the shad, and some other fish of that kind, but we cannot do anything with their State laws. We aimed to get a good law, a codified law, taking in all good features passed, but we found that the enemies of the fish came in and they had two bills by which they intended to upset all the laws that had been in operation for fifteen years. Instead of passing our own law we had to go up and fight their law—and I stayed there watching the thing myself—a committee went up two days before and said it was all right: but if I had not been there they would have passed two laws that would have killed all our legislation for fifteen years. Our chairman got hold of both bills, away on towards morning he put both bills in his pocket and went to the hotel and went to sleep and didn't get awake until too late to pass the inimical bills. That is the way we saved the good legislation, and the main feature of one of those bills was allowing fish netting for certain kinds of fish, for eels and things of that kind, but we knew what it meant—cleaning out all the fish they could. They were going to clean out for market and sale all our streams with nets, and the state propagating them for the angler, cannot maintain prolific streams.

We had a system in Pennsylvania of having a certain number of wardens, say 15 or 20, to cover the whole state. Well, about the time there would be some reported violation on the Delaware he would be off somewhere else, but the last legislature made this rule, and it was adopted, that any infraction of the fishing laws should be brought before a constable of the individual place in the county, and we thought we had every-

thing all right and that we could catch all these violators, but unfortunately the constable, when you told him of these infractions of the law, proved to be a friend of the very man who is violating the laws, and he doesn't prosecute them because they are friendly with him.

Mr. Dickerson: Mr. James says the shad are not contaminated until they get into Pennsylvania. I would like to ask if that isn't due to Pennsylvania politics?

Dr. James: Down in the Delaware they don't get into politics, but as soon as they reach the Pennsylvania line they get strictly into politics.

Mr. Bryant: Just a word upon the subject of the relation of the "Game Warden to Game Production and Propagation." In our State, Wisconsin, the Fish Commissioners have devoted themselves to the work of propagation and distribution. We have there a game warden appointed by the governor, who appoints an assistant, a deputy, whom he sends from one locality to another. Considerable is done there in that way for protection. In our principal lake, Winnebago, one of our best lakes, there has been practically a civil war, a body of fishermen along there being determined to fish whether or no, and the game wardens have fought them; that is, they have interested themselves in keeping the fish supply good, and we have made large distributions. But I may say that for weeks and months there has been a state of constant friction, and at every meeting of the legislature there are acts passed in regard to the fish and game laws. Now, our Fish Commission keeps out of trouble by not having anything to do with the laws for protection, with the result that the Fish Commission can get anything it wants from the legislature. If we want to establish a new hatchery,they ask how much we want, and they give it. Until the legislature of '99 sat, the railways of the state gave us transportation for our cars and employees, and all distribution was gratuitous; but we had a spirit of reform there, and they forbid the issuing of passes to any person in the state employ, and the result is that nobody can receive free transportation. The railway companies, however, will

send our cans and haul our cars free, and they give us mileage for a car, 40,000 to 50,000 miles a year; but in order to comply with the law, we are obliged to pay transportation for our men. The board, however, immediately made an estimate of how much that would cost, and the legislature immediately appropriated funds for transportation. We have found that by keeping the two systems separate, under two different departments, that propagation meets with universal favor; whereas, if we blended the two systems into one and the Commissioners of Fisheries were at the head of game protection, we would have a fight on that would take our whole time.

The President: And you wouldn't get any appropriation?

Mr. Bryant: And we wouldn't get any appropriation. Now, it is simply a question of how much we want, and there never is a whimper or any trouble. We always give them a fair estimate and indicate what we can do. We proceed economically. The Fish Commission does not get much time; we meet four times a year and go around and visit our hatcheries. Mr. Nevin attends to all administrative matters and carries out our resolves. There has been a great deal of talk, and we thought at one time that we ought to take care of the whole business, but experience taught us that all the fight comes on the nets, the size of the nets and what water shall be fished in, and what kind of laws. Of course much of our good work is thwarted by imperfect legislation, but it is better to have propagation going on undisturbed than it is to blend the two together and have both tipped over. The result is that we are, in that State, making headway all the time in securing better protection. The sentiment is growing but it takes so long to focus the belief of public sentiment against the sentiment of localities that it is a rough and stormy road to get any salutary legislation in that way.

A word in respect to carp. We are so well supplied with other fish in our state that the carp is looked upon as a visitation or a calamity. I think we are coming to perceive after all that the carp isn't so detrimental a fish. Within the last five years there has been a strong prejudice against the fish. They say

if you fill our lakes with carp you stock the lakes with hogs and do more harm than you ever did good; but our answer to that is, we always shoulder it onto the United States Fish Commission. (Laughter.)

In our state there is a lot of marshy, reedy, shallow water, hundreds and perhaps thousands of acres, and on the flats, within two miles of where I reside, at Madison, there are countless millions of carp, and the fishermen all say, when they hear them feeding, there is a lot of hogs, because when they are feeding they make as much of a rustle as a drove of hogs would. (Laughter.)

We are coming to find out that the fish have a special use, and do not diminish the other species of fish. I don't know whether the people living about the two lakes have carp, but they have pike fishing—wall-eyed pike and bass fishing. In our second lake there are all kinds of water, shallow water and deep, and they have the black and yellow bass, as the Oswego bass have a yellow hue. The fish are very abundant, notwithstanding a third of the lake, perhaps, is populated with carp thicker than Pekin is with Chinamen.

Dr. James: It is a fish they have a good word for in New Jersey, but I will say this: that New Jersey has but one special fish and game warden, who appoints others under him, and for the State of New Jersey that works admirably. This superintendent sees that the laws are enforced, and every month he publishes a little pamphlet, in which he puts down every infringement of every law, and sends out this booklet, and that has a good effect and a good influence in keeping the people from breaking the law. Our system in Pennsylvania is not so good, because we depend on the constable, and I think New York has something of that kind—very much the same system as ours.

THE VALUE OF THE CARP AS A FOOD PRODUCT OF ILLINOIS WATERS.

BY DR. S. P. BARTLETT, QUINCY, ILL.

I take up this subject with a great deal of hesitancy, knowing what wide discussion it has caused as to its merits and demerits, particularly its demerits, and that the concensus of opinion may be opposite to mine; and who am I that I should attempt to refute such varied authority? But permit me modestly to preface my remarks by saying that I deal with the results of carp planting in Illinois waters alone. Here I know whereof I affirm, and I base my statements upon my experience only, and with profound deference to the opinions of those who may have reason to differ with me.

Without egotism, I think I can safely say that few men in Illinois have a more general knowledge of the waters of the state than I have acquired. Twenty-four years of active work in the Fish Commissions have taught me many lessons, and more than once I have been convinced that I have been all kinds of a crank in that time. The deductions of to-day may be diametrically opposed to those of twenty years ago, made under similar conditions, but with less experience to guide. From the investigations and experiments of the various fish commissions have come many practical results, not the least among which has been the introduction of the German carp. After the United States Fish Commission had increased its output of these fishes to an extent sufficient to give carload lots to the different states, I was instrumental in securing a carload for Illinois, and accompanied the car to the various points where the plants were made, and from these plants has come one of the largest factors in the yearly product of the waters of the state.

It would not be worth while to record here the flood of criticism that followed the introduction of this foreigner into Illinois

waters. This is now only a bit of ancient history, seldom revived. I need only say that the press generally throughout the state made a vigorous "kick" against it, and legislation with a view to limiting the distribution was attempted; yet, while at first I may have had doubts as to the utility of the plant, I stood my ground, perforce, and defended the attacks against it. Public prejudice was largely augmented by the non-success of the many who attempted pond culture of carp, under conditions which would have made any different results impossible. The idea seemed to prevail that anything would do for carp, and starting with this premise, there were at one time six hundred carp ponds in the state, which consisted chiefly of holes in the ground filled with surface water, devoted not to the carp alone, but free to everything else on the farm—horses, cows, hogs, chickens, ducks and geese; and while even then some carp lived and grew, it may be imagined they were hardly fair samples of their kind, and added to these disadvantages, they were taken out for use regardless of conditions, at spawning time, and, when cooked, were, naturally, pronounced unfit for food. A few, practical enough to give them an even chance with other farm products by supplying conditions favorable to the best results, did well with them, and were well satisfied with their reward, but the experience of the many was made the criterion of success, and carp culture on the farm was voted a practical failure. The ponds made for them gradually broke down and the carp were carried through the creeks to the rivers and lakes, and here began their career of use and benefit.

For a great many years previous, on both the Illinois and Mississippi rivers, it had been the practice of fishermen and farmers, in the spring of the year, when the buffalo fish "rolled," to take them by shooting, spearing or with pitchforks, and packed in sugar hogsheads, they were shipped by river to St. Louis and other markets. Those that remained good were sold, the soft and tainted thrown away; the net results were, perhaps, from one-half to one and one-half cents per pound to the shipper,

and a loss to the community at large of thousands of pounds of good food. This improvidence continued, and up to 1880 the output had constantly decreased, until, from the best information we could obtain, only about one million pounds of buffalo were taken on the Illinois river in the season. They were simply "killing the goose that laid the golden egg," taking the buffalo at spawning time they destroyed not only the stock, but the increase as well, until the waters were practically depleted. This being the condition of things at the time of the introduction of the carp, it but remains to show how they improved their opportunity and became a valuable auxiliary to the supply of coarse fishes. For several years the carp were caught, but, having a bad name, the fishermen would have none of them, and they were thrown back into the water. This, as it proved, was fortunate, for they grew and multiplied and the fishermen finally awoke to the fact that there was a practically unlimited market for them in the east at good-paying prices, and began to utilize them. Year after year the catch of carp has increased, until careful estimates show that six hundred carloads of them were shipped east last season from different points on the Illinois river alone. The prejudice against the fish as food had gradually disappeared in this state, until now it is found in the fish markets of every town and village, and on the tables of almost every hotel and restaurant in the surrounding country.

For years, and seemingly to my misfortune, I was held responsible for the introduction and defense of this much maligned fish, and I have had plenty of newspaper notoriety as its advocate, but I have emerged from it triumphant, as it is to-day the universal opinion of every responsible fish dealer on the Illinois River that the carp was the best gift ever made by the United States Fish Commission to the people of the State.

There are natural reasons why the carp should be plentiful in the waters of our State. Not to take too much time, I will briefly say that the Illinois River, with its bottom lands frequently covering fifteen miles from bluff to bluff, abounds in low, flat lakes, into which the fish go with the overflows of the river, which

occur several times a year. The water of these lakes becomes very warm, yet there is sufficient depth to prevent bad results, and here the carp thrive, and from these lakes they are taken for market. The catches are so great as to savor strongly of the traditional "fish story," 25,000 pounds at a haul being not at all infrequent, and some catches have been made that would sound almost fabulous. I append herewith a statement or report of the Illinois River Fishermen's Association, which will give some idea of the financial value of this product to the towns along that river, and when it is considered that very many of the inhabitants of these towns depend upon the fishing industry for a living, the benefit of this replenishment of these almost depleted waters may be understood and appreciated.

Peoria, for instance, ships about two carloads of carp daily during the height of the season. They are packed in boxes holding 150 pounds net of fish. The fish are packed in ice and then placed in refrigerator cars, and not infrequently the fish still show signs of life on their arrival in New York, to which point most of them are shipped. Unlike the buffalo, which must be dressed and packed in ice for shipment, the carp are shipped "in the rough," that is, just as taken from the water, with absolutely no loss or shrinkage from the seine to the dealer, its admirable keeping qualities preserving its edible value perfectly.

At several points on the Illinois River, holding, or live-pens, have been prepared for storing the carp in until the market or the dealer is ready for them. Notable among these storage pens is one owned by Mr. John Schulte. The lake in which it is built is six miles long and averages one-half mile in width. Within this lake he has built a large enclosure, and the fish taken during the hot months are put into it and kept until the market is right, when they are taken out and packed for shipment. Mr. Schulte permits me to give one instance showing the results, financially, of a catch made by himself. The owner of a mill-pond wished to have the carp taken out of it, and gave Mr. Schulte the privilege of taking them. Mr. Schulte showed me a check for $1,080.35 as the net result of the carload he took from that pond.

Buyers for New York houses are stationed at different points on the Illinois River all the time, and readily take all that is offered, just as it comes from the water, at a net price.

I give herewith a couple of letters received in reply to my question as to the value of carp:

Peoria, Ill., December 17, 1898.

Hon. S. P. Bartlett,
Supt. U. S. Fish Commission,
Quincy, Ill.

Dear Sir—In answer to your question as to my opinion of carp, will say, as I have often said, that the carp is the bread-winner of the fishermen and is a cheap food fish in big demand in New York, Boston, Philadelphia and Chicago.

The prejudice against the carp here at home does not apply abroad. Instead of carp being unfit to eat, scavengers living on any thing and everything, devouring the spawn of fine fish, etc., they are a fish of fair flavor for eating purposes, do not eat other than vegetable matter, such as grass, flag-roots, moss, etc., and never eat the spawn of other fish as the black bass does. Often I have heard it said that the carp are driving the fine fish out of the river. This is also far from the truth, as the carp lives in harmony with all kinds of fine fish. The only fish that does not seem to like the carp is the buffalo, and that is because carp are too lively for them and they cannot stand the jumping about of the carp, but if the buffalo have become scarcer, we have their cousin, the carp, to take their place.

In our dealings with our customers since the buffalo have become scarce, in filling our dressed fish orders we have had to substitute carp for buffalo very often. At first there was great complaint, and orders often read: "Don't send me carp if you have no buffalo." We kept on, however, substituting, and now many of the dealers who were so strongly prejudiced against carp order buffalo or carp, and many have written us to the effect that the people like them since they have given them a trial.

In summing up this carp question it can be truthfully said that the general opinion of the public on the question is purely imagination, and has no foundation in fact, and the best evidence of this is the wonderful demand for Illinois River carp from Eastern markets where they are sold for Illinois River carp, and not canned for "salmon," as many people believe.

Most respectfully yours,

(Signed) M. D. HURLEY,
President Illinois Fishermen's Assn.

Havana, Ill., December 21, 1898.

S. P. BARTLETT,
Superintendent U. S. Fish Commission,
QUINCY, ILL.

DEAR SIR—You ask me as to crop of German carp and my opinion of their value.

As to the crop of young carp this season, will say that there is an enormous lot of them, and by next August they will be good, marketable fish, weighing from three to five pounds each.

The Fish Commission did a nice thing when they introduced the German carp in Illinois River. Carp are in great demand and find a ready sale. There is more demand for German carp than for all other fish taken from our rivers combined.

From the information I get, as an official of the Illinois River Fishermen's Association, from all points along the river the carp have brought more money than the catch of all other of our fishes combined. Long live the carp.

Yours respectfully,

(Signed) JOHN A. SCHULTE.

From a commercial standpoint, then, there can no longer be any doubt as to the growing popularity of the carp, and as to one other alleged point against them, I would only say that their in-

troduction has not in any way lessened the angler's chances. Bass are more plentiful now than they have been before for years, and constantly increasing; so are the carp. There would seem to be no need for me to say more in refutation of the oft-repeated charge that carp destroy the bass and kindred fishes. I repeat, I am dealing only with what I know, and what I say applies only to Illinois waters. Possibly, in other places, carp may exhibit cannibalistic and murderous tendencies, but here they get down to business and make money, food and friends.

(Submitted in connection with Dr. Bartlett's paper on the Carp.)

To the Honorable Board of Fish Commissioners of the State of Illinois:

FOURTH ANNUAL REPORT OF THE ILLINOIS FISHERMEN'S ASSOCIATION, compiled from reports received from the different shipping points on the Illinois River, giving the estimated amount and kinds of fish caught and value of same for the past year, ending January 1, 1900.

Shipping Point on Illinois River	German Carp POUNDS	Buffalo POUNDS	Cat-fish POUNDS	Bull Pouts POUNDS	Sun-fish & R. Perch POUNDS	Striped Bass POUNDS	White Perch POUNDS	Croppie POUNDS	Black Bass POUNDS	No. of Turtles Caught
Depue	50,000	100,000	1,000	4,000	1,200	900	4,000	1,000	525	2,000
Spring Valley	45,000	33,500	600	2,100	1,700	575	4,100	400	415	2,000
Hennepin and Bureau Creek	85,000	60,000	2,200	7,000	2,000	1,200	6,000	2,000	930	13,000
Henry and Putnam	300,000	130,000	2,000	31,000	15,000	6,000	25,000	12,000	9,000	17,000
Chillicothe and Lacon	700,000	220,000	2,200	60,000	14,500	6,000	70,000	14,000	6,000	17,000
PEORIA	1,350,000	500,000	1,200	110,000	30,000	8,000	81,000	15,500	9,240	25,000
Pekin and Copperas Creek	360,000	100,000	1,100	49,000	27,500	6,000	2,000	13,090	9,000	18,000
Liverpool	80,000	65,000	18,000	18,000	7,000	1,650	15,000	2,000	4,030	6,000
HAVANA	1,193,990	400,154	18,000	94,100	37,000	13,266	43,280	18,500	12,061	28,000
Bath	100,000	100,000	8,000	16,000	23,000	7,000	14,500	12,000	2,070	16,000
Bluff City	85,000	61,000	1,000	5,000	5,000	500	2,000	200	400	2,000
Browning	475,000	308,000	45,000	9,000	18,000	3,000	8,000	2,000	1,700	4,000
BEARDSTOWN	908,000	700,000	24,000	59,500	23,000	12,000	49,000	10,000	4,100	18,000
Meredosia	160,000	100,000	10,000	13,000	15,000	5,000	3,000	2,000	2,500	12,000
Naples	100,000	90,000	1,700	2,000	19,000	3,000	4,000	1,000	1,850	900
Valley City	60,000	90,000	8,000	2,000	2,000	2,100	10,000	1,500	1,000	1,000
Pearl	90,000	120,000	20,000	1,000	1,700	1,500	10,000	1,800	1,400	6,000
Kempsville	40,000	220,000	20,000	5,000	1,250	8,000	75,000	1,500	1,500	5,000
Hardin	22,000	146,500	19,000	5,000	1,500	1,300	15,700	2,000	1,000	4,000
Grafton	20,000	100,000	40,000	6,400	7,000	5,000	18,000	2,000	1,500	6,000
Pounds of each Species	6,332,990	3,143,154	241,000	499,100	252,050	92,931	459,580	114,490	70,221	202,900
Value by Species	$189,980.70	$94,294.62	$9,640.00	$19,964.00	$7,561.50	$4,646.55	$13,787.40	$6,869.40	$7,022.10	$8,471.50

	Pounds	Value
Carp	6,332,990	$189,980.70
Buffalo	3,143,154	94,294.62
Cat-fish	241,000	9,640.00
Bull Pouts	499,100	19,964.00
Sun-fish and Ring Perch	252,050	7,551.50
Striped Bass	92,931	4,646.55
White Perch	459,580	13,787.40
Croppie	114,490	6,869.40
Black Bass	70,221	7,022.10
No. of Turtles, 202,900	.....	8,471.50
TOTAL	11,205,516	$362,246.77

GRAND TOTAL, { Pounds.... 11,205,516
Value $362,246.77

M. D. HURLEY, President,

JOHN A. SCHULTE, Treasurer,

ALEX SARGEANT, Secretary, Preoria, Ill.

METHODS AND RESULTS IN CONNECTION WITH THE PROPAGATION OF COMMERCIAL FISHES FOR THE GREAT LAKES.

BY FRANK N. CLARK, NORTHVILLE, MICH.

(Speaking) I will say, gentlemen, that this short paper was prepared rather hurriedly, as I have been very busy this season. I ought really to present you a better paper, considering the subject that was given me to write upon, because it is a subject that I should be familiar with, so if it is not what you might expect from the title, you will have to bear with me.

(Reading) Methods and results are correlative; they bear reciprocal relation. The success of the latter measures the degree of perfection in the former. Following this law I desire to make reference more particularly to results which, according to my belief, determine the practicability of methods employed.

To study in a thorough manner the results attending the culture of the commercial fishes of the Great Lakes would require complete statistics difficult to procure. It is not my purpose to elaborate on this subject, but to curtail and particularize, giving you only the summary of my observations on the line of whitefish culture.

The beneficent results accruing from the planting of whitefish fry in Lake St. Clair, Detroit River and Lake Erie by the Michigan Fish Commission of Detroit, by the Canadian Government, and by the United States Fish Commission station at Put-in-Bay, Ohio, are too evident to admit of doubt. The methods pursued and the results obtained in the waters of Lake Erie and tributaries suggest to my mind some practical facts worthy of consideration.

Reliable statistics will substantiate my statement that more than one-half the whitefish fry ever planted in the Great Lakes have been deposited in Lake Erie and tributaries.

The heaviest take of whitefish recorded last year to any water area of equal dimensions was credited to Lake Erie and Detroit River.

Fewer whitefish fry have been planted in Lake Ontario than in any other one of the Great Lakes; the value of its commercial fisheries suffers proportionately. The whitefish fishermen have practically abandoned the lake.

Statistics prove that whitefish were once more plentiful in Lake Michigan than in Lake Erie. According to figures from the Washington office of the United States Fish Commission the catch of whitefish in Lake Michigan in 1880 was on round numbers 12,000,000 pounds, while in Lake Erie during the same year less than 3,400,000 pounds were taken.

The conditions to-day are reversed. Since that date Lake Michigan has shown a gradual decline in that industry. During the year 1897 only about 4,000,000 pounds (in round numbers) were taken from Lake Michigan.

The whitefish industry of Lake Erie is being developed while that of the other lakes is hardly holding its own.

The whitefish industry of Lake Erie now ranks first and that of Lake Michigan follows.

There has been a gradual increase in the annual catch of whitefish in Michigan waters of Lake Erie since 1893, the take of 1899 being more than five times that of 1893 and more than twice as heavy as any previous annual catch for the past ten years; and it is probable that the catch has not been so good for twenty years or more. The statistics for Lake Erie (i. e., the whole lake) for 1899 are not yet completed, but they will undoubtedly show an increase of 50 to 100 per cent over the catch of the preceding year.

Reports from the fishermen (such information as I have gathered by letter and through conversation) seem to indicate that Lakes Michigan, Superior and Huron are holding their own fairly well and that there will undoubtedly be a slight increase over the catch of last year.

In Lake Erie a remarkable increase will be recorded for the

whole lake. The statistics for 1900 I have not, but during the five years between 1895 and 1899, inclusive, the United States Fish Commission planted in Lakes Superior, Michigan, Huron and Ontario a total of but 185,038,000 whitefish fry while during the same period the same Commission planted 443,677,000 in Lake Erie alone.

Thus it will be noted that the United States Fish Commission has planted in Lake Erie during the five years more than twice as many as in all the other lakes combined; in round numbers, a total of but 186,000,000 in Lakes Superior, Michigan, Huron and Ontario combined, and 444,000,000 in Lake Erie alone.

These figures, of course, do not represent the total plant for the five years; they do show what the United States Commission has done.

In addition, the States of Minnesota, Michigan, Wisconsin, Ohio, Pennsylvania and New York have made plants, and also the Canadian Government. Statistics show that prior to 1890 a total of 736,429,000 whitefish fry were planted in Lake Erie by the United States Commission and by the different State Commissions.

The superior condition of Lake Erie's whitefish industries I attribute to two chief causes:

(1) Very heavy plants of fry have been made; more than one-half of all the whitefish fry ever placed in the Great Lakes have been planted in Lake Erie.

(2) The fry have been planted direct from the hatcheries. The proximity of the hatcheries to planting grounds enables the planting of the fry at the right age. It is not necessary to haul them several hundred miles over land, they need never be held too long, and they can be planted at just the proper time and in the very best condition.

In other words, the bulk of the fry planted in Lake Erie and tributaries have been planted from adjacent hatcheries by tug with no bad effects from the act of transporting.

The refusal of the different railroad companies to hereafter

haul free the cars of the United States Commission is, with present facilities, at least a partial barrier to an elaborate and successful prosecution of the whitefish and lake trout work without tremendous cost.

The establishment of auxiliary stations, however, near suitable planting grounds on the Great Lakes would remove these difficulties.

The auxiliaries need not be run more than two months in the year; there would be practically no expense in transferring the eyed eggs from the primary stations to the auxiliaries. The people are now demanding results. In order to have them throughout the Great Lake region, the Lake Erie methods may well be extended to the other Great Lakes. This work is of a national character and should be prosecuted by the United States Government.

At present no other lake has such extensive facilities for the hatching and planting of artificially (so called) produced fry as does Lake Erie; note the correlative results. If the industry can be built up in Lake Erie, so it can in the other lakes by the application of like causes.

In consequence of the enormous expense to be incurred in future years by the movement of the cars to planting points, and in view of the more practical side of the question enabling us to plant by the outlay of less funds many more fry in better condition, it appears to me that an ever increasing population and an insatiable market will eventually necessitate the establishment of several auxiliary stations adjacent to suitable planting grounds on the Great Lakes.

By such practical provision the funds would be applied in the most direct way to the work of replenishment.

At Put-in-Bay the whitefish fry are dipped from the fry tanks into kegs as soon as hatched and immediately transported to natural spawning grounds on the reefs and there planted. The plants in Detroit River from the Detroit hatchery have been made practically in the same manner.

At the Detroit hatchery this past season no fry were held

longer than 24 hours; two large collecting tanks were used and cleared alternately of the fry every 24 hours.

The fry were admitted to the river through a large rubber tube extending below the surface of the water and connecting with a large iron tub on the deck of the tug; while the tug was moving slowly the fry were poured into the iron tub and they of course found their way through the rubber tube into the river, care being taken to keep the tub full of water and fry until the last of the fry were planted.

From a practical standpoint, it appears to me that there is but little opportunity for improvement in the present method of fry production. But if protected propagation is to provide also for the development of the output, there is a vast unexplored field before us.

Countless millions of fry can be called into existence by assisting nature to the mere extent of allowing her to assert herself unmolested, but when the fry stage is reached a far graver question stumps the student of modern fish-culture. The mere production of the fry, should the good work end there, availeth nothing; it is the maintenance of the same and the maturity of the living germs that really constitute the chief aim of our work.

Where shall the fry be placed in order that they may be subsisted and made to grow?

Truly they can be placed on natural spawning grounds and thus given an equal opportunity with nature's fry to battle for existence.

But who knows positively that spawning grounds are the true feeding areas for the newly hatched fry? In the first stages of reproduction the utter lack of solicitude, or even provident instinct, in the parent specimens resulting in such desolate waste (in nature's haunts) of the great reproductive possibilities so generously endowed by nature warn us and our investigation lead us to conclude it more than likely that not a single trace of anxiety is manifest in the parent fish for the well-being of the fry. When we consider the infinitely small percentage of fertilization in the natural state, and the lavish, reckless, extravagant

and wasteful manner in which the eggs are deposited, it leads us to infer that the instinct of the reproducers (adult specimens) can surely extend but little further than a promptitude to the selection of grounds favorable to the mere act of spawning. Whitefish and lake trout are not bed guarders, as is well known, and the eggs after being expelled from the body are forever discarded.

Then why should we accept it as conclusive that spawning grounds are really the proper places to deposit the fry from our hatcheries?

Then how could parent whitefish and lake trout evince sufficiently provident care to select a locality where less enemies abound and also consider the prevalence of abundant food for the resulting fry?

Is it not possible that all the necessary conditions are not favorable to any one locality? Then the work of the scientist is doubly necessary to determine the true planting grounds for hatchery fry. The character and formation of the honey-combed reefs, ledges of limestone rock, etc., that constitute the spawning ground for whitefish would seem strange for the predominance of minute life, either animal or vegetable. Grounds of this nature are practically barren of vegetation and consequently unfavorable to the development of fundamental water life.

Yet we cannot with certainty know that better planting grounds exist until practical investigations are consummated and the proper localities determined by scientific study into the plankton life with the food question in view. It is very natural to suppose that the predatory fishes are familiar with the location of the spawning areas of whitefish and lake trout, etc., and that there are decidedly better localities for the welfare and safety of the fry.

Although conceding, without a shadow of uncertainty, that the natural spawning resorts (with their rock crevices, etc.) afford excellent accommodations during the period of incubation, I shall continue to believe that better planting areas exist, until the fact is proven to the contrary. The solution of this question

would be a great stride towards the perfection of protective methods; no importance, however, should be detracted from necessary and co-operative laws essential to the re-establishment of the commercial fisheries.

The importance of scientific research is obvious, as the nature of the spawning beds is indicative of the fact that nature guides the parent whitefish there solely with a view to the protection and welfare of the ova, not the fry.

It has required the planting of many millions of whitefish fry in Lake Erie and tributaries to stem the tide of depletement and to reverse conditions but recently unfavorable to the ultimate re-establishment and maintenance of the industry on that lake.

In other words, vast numbers of whitefish fry, subsequently unaccounted for, have been liberated in the said Lake and tributaries.

Although the good results have come, there has been an enormous waste of fry somewhere. Is it necessary that such large quantities of fry must be destroyed every year in order that only a few more fortunate ones may reach maturity? This is beyond the scope of the practical fish-culturist. Can the scientist aid us by investigating into the causes of such wholesale mortality or destruction? Do the fry die of starvation or do they become food for predatory fishes?

The gratifying results from Lake Erie waters have not been produced without the application of wholesale methods, and necessarily enormous losses have been sustained and over-balanced by exceptionally heavy plants of whitefish fry. The same conditions may be brought about in Lakes Superior, Michigan, Huron and Ontario by very extensive planting, but it will certainly require that unless a solution of the food question and the location of better planting grounds be determined. By practical experiment it has been proven that Detroit River contains food favorable to the growth of whitefish fry, and the river undoubtedly affords excellent planting ground.

It is natural to suppose that by the current of the river the fry are brought in contact with the plankton life on their down-

ward course toward Lake Erie, and enter the lake through the influence of "a natural distributor," so to speak. From the Northville Station this past year we planted nearly 7,000,000 lake trout fry in Michigan waters of the Great Lakes. The number of pounds of lake trout caught during the year in Michigan waters of the Great Lakes is, in round numbers, about 7,000,000. Now, allowing that the fish would average five pounds each (which is a low estimate), just about 1,400,000 lake trout were caught during the year 1899. Now, supposing that of the 7,000,000 lake trout fry planted from the Northville Station one of every five reached maturity and averaged five pounds. It is readily seen that (should these proportions be kept up from year to year) the plants from Northville alone would keep up the supply of all the Michigan waters of the Great Lakes, the catch being regulated by the number of fry planted, to say nothing of the aid by natural production. And this allows for a loss of 80 per cent of the fry planted! These facts impress one with the thought that the work of the practical fish-culturist to the stage of fry production has about reached the limit of practical perfection.

The production of the fry constitutes only the fundamental operations of protected propagation; the maturity of the same is the consummation of the art, the result desired.

It is now a question of fry maintenance, rather than of fry production, that confronts us. It will eventually be solved, as "Necessity becomes the mother of investigation."

DISCUSSION OF MR. CLARK'S PAPER.

Mr. Bryant: Mr. Clark expressed doubt as to whether the planting of fry on the natural spawning grounds was the best place to make such plants. If you deposit fry there that are hatched artificially, wouldn't they have the same instinct as the fry that hatch on their own ground, and wouldn't they go to the very places, in search of food, as the fry hatched there?

Mr. Clark: What I would say in regard to that is, we know the whitefish are decreasing, except where the fry have been

planted in large numbers under favorable conditions, as in the Detroit river, which distributes them over large areas. Now, we do know that many of the best spawning beds of the whitefish have been destroyed and may not now be the best place to deposit the fry, if they ever were. For example, Thunder Bay, in Lake Huron, was formerly a natural spawning ground for whitefish, but it is not so now, probably on account of the sawdust and refuse spread over the bay from the Thunder Bay river. The main question is, do we get the results that we should from the number of fry planted?

Mr. Bryant: You deposit elsewhere than in the river?

Mr. Clark: Yes; certainly. For instance, take it at Alpena, we hatch between thirty and forty million that are distributed by boat from Alpena up and down the shore; perhaps fifty to seventy-five miles each way. Of course they are not scattered broadcast. The sum and substance of the thing is right here, Mr. President: We are working to some extent in the dark. I mean in the present years. We know to-day, Mr. President, that if we have 10,000,000 whitefish eggs we can tell just how many whitefish fry we are going to have one year with another, just how many fry, and I claim that that part of the fish-culture work has reached its limit. I claim that we have reached the highest practical limit in that direction. Now we want the scientists or somebody to step in and tell where the young fish should be planted to insure the best results.

Mr. Geo. T. Mathewson: I don't know anything about whitefish culture, but down in Connecticut we place the fish in ponds and hold them there. We are getting good results by taking our shad fry and putting them in our shad ponds and holding them there until October.

The President: I will inquire of Mr. Clark what he has to say on this subject.

Mr. Clark: Mr. President, that brings out the question of rearing fish for distribution. It is all right, I tell you, when it is practical. I would like to see it done, but how are we going to do it with the whitefish without an enormous expense? With the

shad you can do it only in a limited way. Neither you nor the United States Fish Commission have ever held 100,000,000 fry, and with the whitefish we must have the right kind of enclosures, and it means millions of money in order to do it right. (Applause.)

Mr. Davis: Isn't it a fact, Mr. Clark, that the disappearance of the whitefish is largely due to the increase of the fishermen's methods of taking them? We have one man who is fishing to-day with 75 miles of nets in Lake Michigan, and when there are nets in that lake that will extend around the entire area of the lake once and a half, is it any wonder that the fish are disappearing?

Mr. Clark: If you will read the papers and reports on this point, you will find that the theory we take is that the mature fish are there for the purpose of being caught out if you but replace with fry, and the food is there for the fry, if it hasn't been destroyed by sewerage and refuse. Now, when you replace with fry, you may take out all the adult fish; I don't care whether a fisherman has one net or 75 miles of nets. If this is not a fact, how is it that the whitefish are increasing throughout Lake Erie, where there is far more net fishing than in Lake Michigan. We caught last year, on the Detroit river, which all the Michigan men know, more than double the amount of whitefish taken there five years ago, and I do not think we had as many nets.

Mr. Ravenel: I would like to say to the gentleman from Connecticut relative to the distribution of the yearling whitefish, that the government would have to acquire property and build ponds, and it would be necessary to get the congressmen interested in it, and then after we have gotten the appropriation we must enclose an immense area to supply food for the young fish. The same question is involved in shad culture. We annually distribute millions of shad fry, and the supply of shad on the Potomac, where they have been raised to a considerable extent, has not been any better sustained than on the Delaware river, where only fry are planted. That is no argument, however; for the expense has been the only thing that has deterred us from under-

taking to raise more yearlings. It might be better, I suppose, to hatch 10,000,000 and raise them.

Mr. Stranahan's report for 1899 touches upon the question of fry distribution and suitable localities. He has made some very interesting observations. He claims that under certain conditions of the water the natural food of the whitefish is not to be found; that when the water was clear and cold he has made examinations and found the food in abundance, and he recommends very strongly that the planting of whitefish be governed by the condition of the water. Furthermore, whitefish are distributed over a very large area. They are siphoned from the hatchery into a large tank on a vessel, and as the vessel runs along at the rate of eight or ten miles an hour the fry run out into the water through a rubber pipe, so they are well distributed.

Dr. James: It seems to me that we are coming to the time when we will encourage the catching of all the older fish; that the time will come when with the fish that have once spawned, it will be a great deal better for the people to catch them. The laws which limit the catching of trout under a certain number of inches are right. Let all the older fish be caught and consumed by the people, but save the younger fish for propagation; give them a chance to spawn, that is my idea, and keep on propagating as we are now doing. The great trouble is to get uniform laws, but if you furnish fish five inches long and put them in the Pennsylvania waters they will all be snapped up. These fish get no chance; you get no good from them. You simply, by putting the fish there, feed the men who take them out, so we want to have a limit and permit them to do one spawning.

THE CLOSE SEASON FOR FISH.

BY DR. B. W. JAMES, PHILADELPHIA, PA.

(Speaking): Mr. President and Gentlemen—I simply aim to call attention to a subject which I think we have not discussed in this society, and that is, "The open and closed season for trout and the better class of food fish." It is a subject which should create some little debate, and I thought we might exchange views, so I wrote this brief paper, "The Open and Closed Season for Fish, Birds and Mammals, More Particularly Fish."

(Reading): Next to the subject of the size of the various fish to be caught comes that of the open season for their catching, and the close-season for their spawning, and we can easily see that this will vary in different States and streams of this continent on account of the variation of the temperature between the Canadian streams and the warm shores of the Gulf of Mexico, and the State laws will vary a little. While there is some variation due in this way, there is still a period within possibly two or three weeks at the very farthest of variation only to be allowed for those fish which populate different streams, such as shad, salmon, herring, etc., while the brook trout, which usually inhabit cold localities, and of course do not exist in streams of the lower portion of the country, might be said to require almost a uniform period for the close-season. The period in three or four of the States into whose interior the larger streams extend, such as the Hudson in New York, Delaware and Susquehanna in Pennsylvania, and others in Maine, Massachusetts, Connecticut and other States only will be referred to. In the State of Pennsylvania we find the following law in force:

OPEN SEASON FOR GAME AND FISH IN THE STATE OF PENNSYLVANIA—1899.

FISH.	LAWFUL TO KILL.
Black bass and all others	May 30 to Jan. 1.
Sea salmon	March 1 to Aug. 15.
Speckled trout	April 15 to July 15.
Speckled trout, Pike County	May 1 to Aug. 6.
Lake trout	Jan. 1 to Sept. 30.
Pike or pickerel	June 1 to Feb. 1.
Susquehanna salmon	May 30 to Jan. 1.
Shad	Dec. 31 to June 20.

In regard to birds and mammals it is lawful to kill—

Elk, wild deer or antelope from Nov. 1 to Dec. 1.

Gray, black or fox squirrel from Oct. 15 to Dec. 15.

Hare, commonly called rabbit, from Nov. 1 to Dec. 15.

Quail, or Virginia partridge, from Oct. 15 to Dec. 15.

Rail birds or reed birds from Sept. 1 to Dec. 1.

Wild turkey from Oct. 15 to Dec. 15.

Ruffed grouse, commonly called pheasant; or pinnated grouse, commonly called prairie chicken, from Oct. 15 to Dec. 15.

Upland, or grass plover, from July 15 to Jan. 1.

Wild fowl from Sept. 1 to May 1.

Woodcock, during July only, and subsequent season, from Oct. 15 to Dec. 15.

The main features of our Pennsylvania State laws are as follows:

Sunday shooting is prohibited under a penalty of $25.00.

"There shall be no hunting or shooting on Sunday, penalty $25.00. That it shall be unlawful to kill, entrap or pursue with intent to kill, any elk, deer, fawn, wild turkey, pheasant, grouse, quail, partridge, or woodcock for the purpose of selling the same, or to ship any of the above game out of the State; penalty, $100.00 for every elk, deer or fawn so taken, purchased or sold, and $25.00 for every wild turkey, pheasant, grouse, quail, partridge or woodcock. Unlawful for any one person to kill in any one day more than 15 quail or Virginia partridge, or more than 10 woodcock,

or more than 10 ruffed grouse (commonly called pheasant), or more than 2 wild turkeys, or to kill in one season more than 2 deer. Unlawful to use dogs in hunting for deer, under a penalty of $100.00. Dogs pursuing deer may be killed. Hunting rabbits with ferrets prohibited."

The general features of our fish laws in the same State may be found summarized in the fifteenth annual report of the Pennsylvania Fish Protective Association, and is as follows:

SUMMARY OF FISH LAWS.

Nets and Set Lines.—Fishing with nets in the inland waters, and set lines, is positively prohibited by the laws of this State. Penalty, $100.00, with forfeiture of nets, boats, etc.

Fish Weirs, Etc.—Fish weirs, fiish baskets, and Fyke nets are prohibited by the laws of the State. Penalty, $50.00 for first offense, and $100.00 for second offense.

Dynamite and Explosives.—The use of torpedoes, giant powder, nitro glycerine, dynamite, electricity, lime or any other poisonous or explosive substance of any kind for catching or taking fish is strictly prohibited. Penalty, $50.00 and imprisonment.

Fish Under Size.—The catching of black bass and wall-eyed pike under six inches, and trout and rock bass under five inches in length, is prohibited in any of the waters of the State except the Delaware River, where it is illegal to take black bass or wall-eyed pike under nine inches in length. Penalty, $10.00 for each fish.

Penalty, $10.00 for each bass, speckled trout, lake trout, Susquehanna salmon or wall-eyed pike, pike or pickerel taken out of season.

Penalty, $20.00 for each sea salmon taken out of season. Those under three pounds must be returned to the water.

Fish wardens, constables or any officer of the State, are authorized to arrest without warrant any person violating any of the fish laws. One-half of the penalty goes to the informer.

In our neighboring State of New Jersey we find the following laws in force, as given by the Board of Fish and Game Commissioners:

OPEN SEASON FOR GAME AND FISH IN THE STATE OF NEW JERSEY—1899.

FISH AND GAME.	LAWFUL TO KILL.
Hare, rabbit and quail.....	Nov. 10 to Dec. 31.
Woodcock.....	July, Oct., Nov. to Dec. 10.
Gray, English or Wilson snipe..	March, April and Sept.
Partridge, grouse or pheasant..	Oct. 1 to Dec. 10.
Reed bird, rail bird or marsh hen.	Aug. 25 to Dec. 31.
Gray, black and fox squirrels.....	Sept. and Nov. 10 to Dec. 10.
Grass or upland plover and dove...	August and September.
Geese, duck and other web-footed wild fowl.....	Jan. 1 to May 1 and Sept. 30 to Dec. 31.
Brook trout.....	April 1 to July 15.
Black bass.....	May 30 to Nov. 30.
Pickerel.....	Jan. 1 to Feb. 20, and May 1 to Dec. 31.

The killing of deer and long-necked pheasants is prohibited at all times.

The Forest, Fish and Game Laws of the State of New York may be summed up briefly, as follows:

"Trout, close season.—The close season for trout shall be from September 1st to April 15th inclusive. Trout shall not be sold or possessed in any county during the season that is closed throughout the entire county. Trout less than six inches in length shall not be taken or possessed, and if taken shall without avoidable injury be immediately returned to the waters where taken."

"It is unlawful to take fish or game during the time described as 'close season.' Fish and game for which close seasons are established may be hunted and caught in a lawful manner duing that part of the year which is not included in such close seasons respectively. The 'open season' is that part of the year year when they may be taken in a lawful manner."

"Close season established in towns.—The commission may, on the request of a majority of the town board of any town in

which fish have been or shall be placed at the expense of the state, prohibit or regulate the taking of fish from public inland waters therein, for not exceeding five years, from the first of May next after such fish have been furnished. At least thirty days before such prohibition or regulation shall take effect a copy of the same shall be filed in the office of the clerk of the town to which the prohibition or regulation applies, and printed copies thereof at least one foot square shall be posted along the shores of the waters affected not more than fifty rods apart."

CLOSE-SEASON FOR FISH IN THE STATE OF NEW YORK.
1900.

FISH.	UNLAWFUL TO KILL.
Trout	Sept. 1 to April 15
Lake trout	Oct. 1 to April 30
Black bass	Jan. 1 to June 15
Pickerel and pike	March 1 to April 30
Muskalonge	March 1 to May 30
Salmon	Aug. 15 to March 1

The examples of these three states will probably give about the average for the Eastern and Northern States, and as I have not the data from other states which is required for a complete paper on this subject, I will simply bring out the points which seem most worthy of debate in the different states at the present time, and the imperfect workings of the laws which are not harmonious in the different commonwealths.

For instance, we find in the Philadelphia markets, extending over quite a season beyond the limit set for the killing of certain game and fish, an abundance of such upon the market stalls, for a considerable time after our close-season; the law simply prevents their being caught and killed here, while just across the border the close-season may extend to two, three or four weeks longer than ours, and they could be thus and are unfairly sold in our markets on account of such an extended season. This point, however, the commissioners and those interested in the enforcement of our fishing and game laws are aiming to prevent by having an enactment passed which will prohibit their sale or

use beyond the exact requirement of the state law on the subject. This should be done in all the states in order that uniformity may prevail in a matter so important to the fishing interests of the individual commonwealths.

At the last session of the Pennsylvania Legislature we aimed to have the length of trout and some other fish limited to one or two more inches. Brook trout, now 5, we wanted 7 inches. But the opponents of good legislation aimed to pass bills which would open the streams to netting and similar methods of depopulating the waters which the fish commissioners had propagated and placed there for keeping the streams well stocked, and as we all know this stocking cannot be effectively done unless there is a protective law against the cleaning out by nets of the fish which the fish commissioners, through their propagating stations, are constantly keeping well supplied by annual delivery of fry to the different streams for the various kinds of fish throughout the State, the subject of the close-season is a vital one for our consideration, to bring out and show the differences to which I have referred. It is to evoke valuable discussion on this subject that I have prepared this brief paper.

DISCUSSION OF DR. JAMES' PAPER.

Dr. James: Why we aimed to get the legislature to change the trout from 6 to 7 inches was that we wanted the trout to get time enough to spawn for one year, but the legislature would do nothing for us at its last session—meeting every second year only—we have had to leave the short five-inch trout to be the rule. We thought we could get a six-inch limit, and then at the next legislature seven, but failed.

We aimed some years ago, and this society had a committee appointed, Mr. President, whose duty it was to ascertain if the legislatures throughout the country would not enact uniform laws, but we found a great difficulty to get them to do what was wanted, and that is what we find in regard to this matter now, still it is a subject which we really ought to take up again and see if we cannot come to some conclusion in regard to uniformity in this matter all over this country at least.

Mr. Brewster: The laws of the State of Michigan get at that very nicely. By an act of the legislature of '93, one of the sections states that "it shall be unlawful to sell or offer for sale, or have in possession for the purpose of sale, any birds, game or fish," and their sale was prohibited by the State of Michigan in any case. That was afterwards modified to cover the sale after the closed season began.

The President: I will inquire of Mr. Brewster how he gets along with the stock of game or fish on hand when the close season begins, supposing that at the end of an open season on the grouse or deer, parties have them in their possession.

Mr. Brewster: By another section they are allowed to have them in their possession, but only for their own consumption, and in all cases it is for the defendant to prove that they are in his possession for that purpose. The sale of quail and partridge is always prohibited in the State of Michigan; they are not allowed to be sold at any time.

The President: You keep the cold storage plants closed up in those respects?

Mr. Brewster: Well, that is the law. I think it is as well observed as almost any other police regulation. Of course there are some cases where prosecutions have been had and held against cold storage. Within the last year the cold storage and game houses were cleaned out thoroughly. I don't remember exactly what quantity was taken. Mr. Morse is here and knows, but a very large quantity was condemned and turned over to the state institutions for their use.

MICHIGAN GRAYLING.

(Thymallus Tricolor.)

BY A. C. BABBITT, WILLIAMSBURG, MICH.

Dr. Henshall's papers on Montana grayling were deeply interesting to me, carrying my thoughts backward to a time when Michigan's type of the species—Thymallus Tricolor—were almost the sole occupants of at least one thousand miles of limpid, running spring water, of varying width and deepness, threading the pine-clad sections of twenty-three counties of the Peninsular State lying north of a line drawn from the south line of Oceana County, on Lake Michigan, running northeasterly to the lower side of Arenac County, on Saginaw Bay. In the early seventies most of the streams and tributaries in the following list were literally overstocked with grayling. The northern portion of Arenac County is traversed by the Au Gres River, which mingles its waters with those of Saginaw Bay. From thence north, flowing into Lake Huron are the Au Sable, Black, Pigeon and Sturgeon Rivers, besides two branches of the Thunder Bay River—the Rainy River and Canada Creek. From the apex of the peninsula south, the waters of Lake Michigan receive those of the Maple, Boyne, Jordan, Boardman, Manistee, Little Manistee, Pere Marquette, White and Muskegon Rivers, all of which were originally the home of grayling. The one grayling stream of the Upper Peninsula is the east branch of the Ontonagon River, which empties into Lake Superior west of Keweenaw point. By coast line the mouth of the Ontonagon is upwards of four hundred miles from the coast to the Lower Peninsula. On account of the strictly non-migratory habits of the Tricolor it would seem that the Ontonagon specimen should receive a separate classification.

My acquaintance with grayling dates from the winter of 1872 and '73. A year or two previously Dr. J. C. Parker, of Grand

Rapids, had identified the species, from specimens taken from one of its most southerly habitats, Hersey Creek, a branch of the Muskegon River.

We early settlers of Crawford County, however, were ignorant of the fact, and many long evenings were partly taken up with discussions as to the identity of the fish with which the streams of that county abounded. Supposedly a species of trout, its specific name depended on the particular stream from which it was taken. In that locality it was generally designated Au Sable or Manistee trout. By some, however, it was claimed that this stranger was no trout at all, but more likely a "cisco" or "jack salmon;" while others, wiser in their own conceit, pronounced this rara avis a "cross between a sucker and lake herring." In 1875 the upper portion of the Au Sable and Manistee rivers retained yet their primal beauty; their stock of grayling was practically intact; a catch of fifty pounds was not an uncommon thing as a result of one day's fishing with a fly rod. By this means the demand from Chicago, Cincinnati and Detroit for grayling was over-supplied, so little was this delicious table fish known. As its fame as a game fish and an epicurean dainty spread, fishermen came from afar, who almost invariably pronounced it superior to brook trout in both of these qualities. It is to be hoped that an effort will be made to propagate Thymallus tricolor by methods similar to those employed in the propagation of its congener in Montana. Two questions in regard to tricolor have for some time engaged the attention of fish culturists: First, inquiry as to the cause for the rapid depopulation of grayling streams; second, why have attempts at artificial or protected propagation of the species been economic failures? Owing to the gregarious and fearless nature of tricolor, I believe that the same amount of fishing on a grayling and trout stream of similar character would make a greater impression on the stock in the grayling stream than in the trout stream. The real cause for the practical extermination of Michigan grayling, however, has been logging operations.

On account of their peculiar spawning habits, the log drive

has, year after year, practically shut out that function, besides undoubtedly destroying numbers of adult fish.

Tricolor habits are, for ten months in a year, strictly local. During this period he will occupy a portion of a river bed circumscribed by one square foot of space. No matter if hundreds are domiciled in a bend of the river, each and every one keeps separate house. If disturbed, driven out, each returns to the precise spot which he formerly occupied. About the 10th of March there is a general exodus from their haunts, a run down stream. When nature prompts their return they begin a lingering ascent or up run, performing spawning functions on the way up stream, at points for which the gravid fishes have a special predeliction, on either sand or gravel, according to the character of their habitat.

Tricolors' habits or preferences are immutably fixed, as unchangeable as fate—she has a preference for a particular portion of the river's bed on which to spawn and there she will deposit her ova or not at all. If a log jam rests on the spot of her choice—as is often the case—being piled from the bottom to the surface of the water, she will hold onto her eggs until the germ dies, rather than cast them in any other place. These traits render it an impossibility to propagate the species anywhere else but in their native haunts.

In short, the Michigan type of Thymallus must have a down run. She must also find her spawning ground unobstructed on her return, or propagation of her kind is off for that season. The experience of several years devoted to efforts at domestication of grayling convinces me that it is impracticable.

I believe, however, that protected propagation of Thymallus tricolor is both practicable and feasable; provided a stream can be found where logging operations are a thing of the past, and where enough grayling have survived to serve as a nucleus for future operations under the protection and manipulation of fish-culturists.

HINTS ON GRAYLING CULTURE.

DR. JAMES A. HENSHALL, BOZEMAN, MONTANA.

The successful culture of the Montana grayling and the safe transportation of grayling eggs, under proper conditions, are no longer matters of experiment. My first attempt, two years ago, to hatch and rear the grayling on the same lines as those usually pursued with trout, was almost a total failure, owing to a lack of suitable conditions and a want of experimental knowledge concerning the character of the eggs and habits of the fry.

The published accounts of the experiments of Seth Green and Fred Mather with the Michigan grayling in 1874 were both meager and unsatisfactory, and availed nothing; nor was I able, subsequently, to obtain any additional or definite information on the subject from Mr. Mather, who seemed to have forgotten all the details connected with his experiment. Both Green and Mather pursued the same method in hatching and feeding the grayling as with brook trout, which leads me to doubt that either of them succeeded in rearing the fry.

In the first place, grayling fry cannot be reared in the hatchery in cold spring water, owing to its low temperature, and the entire absence of natural food; for neither air nor food exists in spring water as it issues from the ground. Neither can the fry be induced to take the artificial food generally used for trout fry, to any great extent, in the hatching troughs.

In my first experiments I was much chagrined and discouraged at seeing the diminutive organisms curl up and drop dead to the bottom of the trough, notwithstanding a great variety of substances had been offered, to induce them to feed.

At this time I was impressed with the apparent resemblance of the grayling fry to the lake whitefish fry, both in size and appearance, which led me to think that they also required similar food. Upon examining the fry under the microscope I discovered

that my surmise was correct, inasmuch as the grayling fry had two fang-like, retrorse teeth, in the upper jaw, similar to those in the lake whitefish fry. This fact at once solved the problem. It was imperative that they be supplied with such natural food as is found only in the water of streams and lakes.

Acting upon this hint I turned all the remaining fry into a sheltered, shallow bight of the creek that flows through the hatchery grounds. There they did well for several weeks, when they sought other portions of the stream.

In the following autumn I constructed a large pond and supplied it with creek water by a ditch 1,500 feet in length. From this pond I supplied the nursery ponds with creek water. By holding a glassful of this water to the light hundreds of small crustaceans (Entomostraca) could be observed, appearing to the naked eye like specks of dust, and this was just what the grayling fry needed, as my subsequent experience proved*

Another desideratum to be considered for grayling fry is the warmer temperature of creek water as compared with spring water. They also need sunshine. While trout fry usually seek the shady side of the ponds, grayling fry prefer the sunny side.

My method is now to transfer the fry, as soon as they begin to swim on the surface of the water in the hatching troughs, and before their yolk-sacs are entirely absorbed, to the nursery ponds. They take kindly to the change, and at once begin foraging for their natural food of crustaceans, insect larvae, etc. They are extremely active for such small organisms, and pursue their minute prey unceasingly. Soon thereafter they can be taught to take liver emulsion, and still later they begin to eat each other, for they are as much addicted to cannibalism as the pike-perch fry. The only remedy for this proclivity is to provide twice as many fry as it is desired to rear, and as soon as practicable to separate the larger from the smaller ones.

*The temperature of my spring water was 45°, and of the creek water, 50°. The importance of creek water is not so much a matter of temperature as that it contains the natural food required for grayling fry in its earlier stage of existence. As a matter of course a temperature of from 50° to 60° Fahrenheit is desirable with fry of any species, in the rearing trough or nursery pond.

In stocking streams with grayling fry it is my opinion that they should be planted within a few weeks after they are transferred to the rearing ponds, or even so soon as they begin to swim freely, as is done with lake whitefish fry—provided that suitable places be selected in the stream. Shallow, weedy situations in the eddies or back water of the smallest tributaries should be chosen There they would find their requisite food, and be safe from the depredation of larger fishes.

At our grayling auxiliary station some two million fry are planted each season in the adjacent creeks as soon as they begin to swim, and the result is very apparent the following autumn, when the waters fairly swarm with grayling fry several inches long. The grayling is quite shy, and a wilder fish than the trouts, and can not be so easily tamed—another reason in favor of their being planted early in life.

A very important matter to be considered when the fry are placed in the rearing ponds, is to see that there is no leakage in the drain boxes, and that the screens are caulked in their grooves, and the screens themselves reinforced by perforated tin of the smallest calibre, otherwise many fry will escape. I have lost thousands from leaky outlet boxes when, apparently, they were perfectly tight. But as grayling fry will worm themselves, at first, through a pin-hole, it is evident that the utmost caution must be observed to prevent their escape.

TRANSPORTATION OF EGGS.

Previous to the present summer I have had considerable trouble in shipping grayling eggs safely. The period of incubation being so short, and the shipment occurring during hot weather, it seemed impossible, with ordinary means, to transport the eggs to a distance without a loss of 25 to 90 per cent, owing to the high temperature to which they were subjected en route.

Heretofore we have used the ordinary egg-shipping case, which, while answering well for trout eggs, has proved a failure, even when well supplied with ice, for grayling eggs. Last winter I devised and built a refrigerator case that has proved to be just the

thing needed. A brief description of this case may not be amiss: The outside box is 30 inches square, and from 12 to 18 inches deep, according to the number of eggs to be carried. An inner wall of light stuff, say one-half inch thick, of the same depth as the outer box, and 27 inches square, without top or bottom, is provided. The space between the outer and inner walls is packed tightly with dry sphagnum moss or dry sawdust The stack of egg-trays is placed in the center of the box, leaving a space of about five inches between it and the inner wall, which is filled with broken ice. On the top of the trays is a hopper with perpendicular sides, four or five inches deep. The vertical sides of the hopper allow free access to the ice-chamber around the stack of trays. The trays are 12 inches square on the outside, and but ½-inch deep. This permits twice as many trays in a stack as with the ordinary trout trays. The eggs are placed in a single layer on each tray, and covered with a piece of mosquito netting in the usual way, but no moss is placed over it, as grayling eggs will not admit of as much pressure as trout eggs; the outer membrane of the eggs is quite thin and easily ruptured. By this method of packing, the eggs are received at Bozeman station in as perfect condition as they leave the auxiliary station, after being subjected to a wagon haul of 45 miles and 250 miles by rail, and at a temperature not exceeding 40° F. This has been, also, the condition in which they arrived at distant points, according to reports received, even, as in some cases, when they were en route a week.

As a matter of experiment, several trays of eggs were shipped but six hours after fertilization to Bozeman station, with the result that fully 25 per cent of the eggs hatched; heretofore similar experiments with green eggs resulted in the loss of all the eggs before their arrival. By maintaining a temperature not to exceed 40° F. the development of the embryo is retarded, and the eggs can be safely shipped to any distance so long as this condition is observed. It is my opinion that grayling eggs can be safely shipped within one or two days after fertilization, but this has yet to be determined by experiment. Should this prove to be true, it will be an important factor where the eggs are to be shipped a long distance, requiring several weeks for the journey.

DISCUSSION OF THE GRAYLING PAPERS.

The President: Gentlemen, have you any remarks to make about these papers on the grayling? I am sorry the gentlemen are not here to answer questions. I want to inquire if any gentleman here has had experience with them, so that they can say what is the most natural temperature for them? I infer that the fry thrive best in a high temperature, and my experience is that the fry do best at about 70 degrees.

Mr. Ravenel: That is sustained by most of those who have received shipments of eggs from us, and I think most of the shipments were received in good condition. At the Duluth station Mr. Wires hatched them in jars; after the fry were all hatched they were poured out on trays. He suffered a heavy loss on account of a sudden rise of temperature, that would have had no effect eight or ten days later. He held them in the Duluth hatchery until the water attained 70 this spring. The change of temperature came just as they were commencing to take food.

The President: May I inquire what you know about the normal temperature of the water where the grayling are indigenous?

Mr. Ravenel: I think the average temperature at Red Rock Lake was 52.

Mr. Bryant: Is there any difference between the Montana grayling and the Michigan grayling?

Mr. Ravenel: I think so. I think Dr. Henshall states the difference, and there seems to be a difference in their spawning habits. The Montana grayling is as easily spawned as a trout.

Mr. Bryant: Which of them is different from the European grayling?

Dr. Smith: Both of our grayling resemble the European grayling very closely; but whether the Montana or Michigan species is more closely related to the European, I can't say.

Mr. Clark: Mr. Chairman, just a word. The Michigan grayling, if caught wild during their spawning season, spawns as readily as trout or any other kind of fish, and gives good hatching results; this was demonstrated on the Au Sable and Manistee

rivers a number of years ago, when something like 50,000 eggs were taken and hatched. But these grayling will not domesticate and mature their spawn when held in ponds.

We have at Northville at present some grayling that are between seven and eight inches long, raised from eggs from Montana. We do not introduce warmer water because they seem to require it, but for the food. These fish were held in troughs until September, supplied with a mixture of spring water at 53 and creek water at 72 or 73, but the creek water was used only for the purpose of adding to the supply of food. Since then they have been in a pond fed with spring water at 53, going down perhaps to 48 in the winter.

The Secretary: I do not think the water should necessarily be as high as 70 to get the best results. Take the Au Sable, once a famous grayling stream, as an example. I have taken the temperature of that stream in the month of August, when the water is about as warm as it ever gets, and it ran from 55 to 60. I did not find it above 60 at the hottest time in August, though it was probably warmer farther down stream. I can't say what the temperature is in April and May, when the fish are spawning and hatching, but it must be a good deal lower.

Mr. Ravenel: I think 60 is a very high temperature in the Au Sable, but Dr. Henshall's whole claim is that they should be transferred to a warmer water just before they commence to feed. It wasn't because he wanted warm water, but because of the conditions that the warm water produced.

Mr. Nevin: I would say that I saw those grayling at Duluth, and I never saw trout eat more ravenously than they did.

Mr. Thompson: We have some grayling at the Nashua station that have been fed nothing but liver. We took some of them out doors and some were left inside in water of 48 temperature—the water outside was 60. Those inside did not seem to have much desire to eat, while those outside ate very readily. We prepared the food, of course, with very great care and also placed them just below some troughs of brook trout we were feeding. The water from the brook trout passed right through

the grayling troughs. We all know that in feeding trout they take the larger particles, and that there is a very fine emulsion that passes through the trough. Our idea was that this would furnish a great deal of suitable food for the grayling, which seemed to be the case, for the one trough outside grew very well. In the hatchery we found difficulty in getting them to take food in sufficient quantities. We transferred them outside, made the conditions the same as with the others, and we can tell by their size in each trough now the relative time at which they were transferred into the warmer water. We fed them at first about six times a day, and found apparently we were not feeding them often enough. Those that got the six feedings and the food from the trout troughs above grew very rapidly, but those that only got the food six times did not thrive. We increased the number of feeds and they seemed to respond very readily. We have some of the fish now, the largest ones about an inch long.

The President: This seems to be quite an experience on the graying, and the subject being new, I trust you will pardon me if I give my experience. We hatched in spring water, piping the water direct from a spring, and my pipe was set up under a tent because I wanted water free from sediment. As the fish hatched we moved them down into the hatchery, with the exception of one trough, which we kept supplied with spring water, not from the spring direct, but from a distributing box. We had connected with that same spring box three other rearing troughs filled with brook trout. The grayling in this one spring box were fed but did not take food readily in a low temperature (of about 48 degrees). They would take very little food, and we lost nearly every fish, and we finally moved two or three hundred fish down into the hatchery. The water in the hatchery is a mixture of river and spring water, and we found from the locations of the different troughs, that the little fellows seemed to do best in a temperature of about 70 degrees. All of these fish were fed on emulsion of liver. When they first began to take food we took our finest liver and set it in a pan of water, and then skimmed off the top for the grayling and let the thicker

portion settle down, and then as they developed a little they would take all the food which we naturally give to the young trout fry and strained it, and all of our grayling have been fed entirely on liver; you might say, they have had no artificial food because all of the troughs in which the grayling are kept are below the troughs in which we have the trout fry. The water passes through the trout box before it reaches the grayling. I think the grayling is the most rapid grower of any fish I have ever had in the hatchery. They have trebled in size since we got them in May. Our experience last season wasn't successful because we got our eggs before they learned how to pack them properly; we only hatched a few, but those fish in the middle of the summer were larger than our trout fry, which were several months older. We have some yearlings and these fry. I think though some of them have disappeared inside of the others for their numbers have decreased—they have gone somewhere.

Are there any further remarks on the grayling?

Mr. O'Malley: I had an opportunity while in Leadville of seeing the grayling carried there and attempted to be reared in that cold water. When I left there the grayling were about a year old, and at that time they were hardly an inch long, and I think according to that it would tend to show that they do better in hatcheries having warmer water. They didn't seem to feed.

Mr. Bryant: I want to ask the Michigan gentlemen about their living in the water with other fish, do they monopolize the stream?

Mr. Willard: I think I can answer that question. I spent the summer of '97 fishing for trout and grayling in Montana, and I found both species in the same water, although I found the grayling more abundant in slow, sluggish parts of the stream where the water was shallower, even where the water must have been higher in temperature, and where I would receive no rise to my flies from the speckled trout.

The President: Do they take the fly well?

Mr. Willard: Indeed they do. I was so pleased with the grayling that I applied to the U. S. Commission and received a

consignment of eggs. We were successful in hatching about 25 per cent of the eggs, but our superintendent seemed to utterly fail in getting them to take any food whatever.

Mr. Dickerson: I remember seven years ago I stood in one spot and caught 47 grayling from one hole. The difference between the trout and grayling is, you catch four or five trout and they seem to put the others onto it and you can't catch any more, but the grayling will bite until the last one is caught.

Mr. Willard: In the Rocky Mountain streams it is generally the same.

THE SPAWNING HABITS OF THE LAKE STURGEON.

(Acipenser rubicundus.)

BY LIVINGSTON STONE, CAPE VINCENT, N. Y.

The first I knew about my being expected to present a paper this year to the Society on the subject of the "Spawning Habits of the Lake Sturgeon," was on seeing in a recent issue of "Forest and Stream" that I was billed to prepare such a paper for this meeting. If it were not for my having been put on the program I should not venture to offer anything on this subject unless it were under the title of "What Little I Know About the Spawning Habits of the Sturgeon."

As a correspondent wrote me recently, "the sturgeon is a strange fish." At least the Lake sturgeon, which is the subject of this paper, is a strange fish. It has a strangely shaped body, a strange head, strange mouth and skin, and a strange appearance generally; and one of the strangest things about the fish is that during the same week and on the same spot you can find female sturgeon with their eggs in almost every stage of development. This throws us all at sea as to their time of spawning, and we are not much better off in regard to their places for depositing their spawn, for if they ever have fixed spawning beds where they go regularly to deposit their eggs, I can only say that I never saw a fisherman yet who knew where those spawning beds were.

Another strange thing about the Lake sturgeon is that the fishermen never, or almost never, catch a spawning female in their nets with ripe eggs in her. They catch them when they are almost ready of spawn, and when they have just spawned, and also with eggs in them in all stages of development, but hardly ever with ripe eggs ready to be extruded.

The peculiarities of this strange fish have made it very diffi-

cult to gather information about their spawning habits and still more difficult to collect and impregnate their eggs.

The first instance that I know of sturgeon eggs being successfully taken and hatched, occurred in 1875, when Seth Green, assisted by Mr. A. Marks, obtained from the fishermen who were fishing at North Hamburg on the Hudson, a ripe male and female, from which four pans of eggs were taken by the Caesarian operation of cutting the fish open. This occurred on the 7th day of June, about 10 a. m. On the 9th day of June, about 3 p. m. the first movement of the embryo was observed. On the 10th of June the eggs began to hatch, and by 5 o'clock the next morning, June 11th, all the eggs were hatched out. The temperature of the water during the period of hatching averaged about 70 degrees F.

In 1888, Professor Ryder, of the U. S. Fish Commission, made a very thorough study of the sturgeon at Delaware City, Delaware. (See the U. S. Fish Commission Bulletin for 1888), and in 1893 Dr. Bashford Dean made some interesting experiments, also at Delaware City, and since that time eggs have been frequently taken from sea-going sturgeon.

All the above experiments and studies have, however, been conducted with the salt water sturgeon (Acipenser sturio).

The Lake sturgeon (Acipenser rubicundus), is another fish, and, as far as I am aware, no extended observations in regard to this fish have been recorded, except those by Mr. William Lang in 1890, for the Ohio Fish Commission.

In the spring of 1899 I received permission from the United States Fish Commission to hunt for ripe sturgeon eggs on Lake Champlain. Two fishermen having located at Alburgh Springs, Vermont, for the purpose of catching sturgeon for the New York market, I arranged with them to have the privilege of examining all the sturgeon they caught before they were butchered; and for the time, established myself at Alburgh Springs with Mr. J. B. Lamkin and Mr. Myron Green for assistants.

On the 18th of May we overhauled our first batch of sturgeon, to the number of sixteen. Two females appeared to

be nearly ripe and we put them in our pens, hoping that their eggs might mature sufficiently in a few days to be taken and impregnated. Of the remainder, ten were males and four were fmales. These were then butchered by the fishermen. On opening the female fish, their eggs were found to be far advanced toward maturity, and it looked as if in a week or two at the latest we should strike fish with fully ripened eggs. In point of fact, unaccountable as it seems, we never caught any sturgeon the rest of the season that had any riper eggs than these had. It is needless to tell the story of our continued disappointments. The fishermen brought in plenty of fish, and allowed us the utmost freedom in examining them or penning them up, as we choose, but although we followed up the sturgeon until the latter part of June, examining them all and penning up what we thought to be nearly ripe, we never came across a single ripe fish or took a single egg. All that we examined were either spawned out or not ripe, and none of those that we confined in the pens seemed to make any progress toward maturity.

I will only state that the fish that we examined seemed to grow less mature, if anything, as the season advanced, and at all times the development of their eggs presented the most perplexing variety. By way of illustration, I will state the condition of the eggs of the female sturgeon that were killed by the fishermen and examined by us on several days. As I said above, the eggs of the fish that we examined on May 18th were in all stages of development. The same was true of those examined on May 25th—although on both days there were some that were very nearly ripe. On the 29th when we had expected to find fish about fully ripe, we examined in all, the eggs of four females. The eggs of the first fish were only half developed,—the second fish had just spawned,—the eggs of the third were just forming, —and the eggs of the fourth were about one-fourth developed. The same discouraging experience continued until the end, when after following the sturgeon thirty or forty miles southward from Albaugh, we abandoned this Will o' the Wisp chase and returned to Cape Vincent Station, it being then the last week in June.

This spring, 1900, I renewed the hunt for ripe sturgeon eggs, this time, however, not in the open waters of Lake Champlain but in the Missisquoi River, a tributary which empties into the lake in the extreme northwestern corner of Vermont. That sturgeon went up this river in the spring just after the run of pike was over, was well known, but whether they ascended the river to spawn, or to feed on the vast quantities of pike eggs and sucker eggs that had been deposited up toward Swanton dam, was not so definitely settled.

There being no funds of the United States Fish Commission to spare this year, for the purpose, no systematic attempt could be made to find ripe sturgeon, but through the obligingness of the river fishermen, and the help of Mr. Myron Green, we were enabled by persevering effort to score some successes and to make a few valuable discoveries.

While the sturgeon were running, there were two gangs of sturgeon fishermen on the river besides those fishing at Swanton dam. We prevailed on these fishermen—I do not know how, and it is a surprise to me yet, for they never had any pay for it—to hold the fish they caught until we could examine them, and also to keep in confinement any that we thought were nearly ripe. In this way we obtained an opportunity to examine over a hundred sturgeon.

Without going into tedious details more than is necessary, I will state as simply as possible the results of our observations, and they are as follows:

(1) The sturgeon do go up the Missisquoi River to *spawn*. This was proved by the fact that the fish going up the river, all had eggs in them of about the same degree of ripeness. Some had eggs that were fully ripe, while all that were caught going down the river had spawned out.

(2) The sturgeon spawn on the rapids below Swanton dam, for they were caught here fully ripe. Mr. Myron Green, who is a very careful and correct observer, thinks that they lie in the deep water below the rapids until they are ready to deposit their eggs, and then ascend to the rapids to spawn. This corre-

sponds to a considerable degree with what has been observed of the spawning habits of the pike perch.

(3) The sturgeon spawning season on the Missisquoi River is very short, and when the spawning is over the fish all go down the river with a rush, and though there may be hundreds in the river one day, in forty-eight hours after there may not be one left in the river. The rush down stream this year was on the nights of the 27th and 28th of May. They began to go up the river about the 20th, although there were sturgeon at the mouth of the Missisquoi River perhaps as early as the first week in May. The sturgeon spawning season on the river this year was, therefore, the week between the 20th and 27th of May.

(4) The sturgeon does not always deposit all her eggs at one time. A female fish whose eggs were so ripe and loose that they came from her without pressure, was found on being killed and examined, to have at least two-thirds of her ovaries filled with immature eggs.

(5) When the female sturgeon is ripe, her abdomen sags when the fish is lifted by the tail, as in the case with ripe salmon. Hence, there is no difficulty in distinguishing a ripe female. Her eggs also flow from her very easily, so easily, in fact, that the difficulty with a ripe fish in artificial spawning is, not to get the eggs out, but to keep them in.

(6) The mystery of the fishermen never catching a ripe fish in their gill nets is solved. It has been unquestionably a mystery why female sturgeon were caught with eggs in every possible stage of unripeness, but never with eggs entirely ripe. It is a mystery no longer, however. The secret of it all is that when the female is ripe the eggs flow from her so easily that when entangled in a net she throws out all her ripe eggs in her struggle to escape, so that when the fisherman takes her out of the net he finds only a spent fish. Mr. Green says that they throw their ripe eggs so readily that even in taking a ripe female ashore from the pens, she would be likely to throw her eggs before she could be quieted enough to be stripped.

Now that this explanation of what has seemed so mysterious,

has been discovered, it appears so simple that the wonder is that no one has thought of it before. Very likely this has occurred to many of you who are here present, but I can truly say that I have never found a fisherman yet, who knew the true reason of his not catching ripe female sturgeon, or one who ever even hinted at it.

(7) We succeeded in actually taking and impregnating a few sturgeon eggs. We found them to be glutinous like pike perch eggs and requiring the same treatment in handling and impregnating.

The eggs are about one-eighth of an inch in diameter, and can be readily hatched in the same jars that are used for hatching whitefish and pike perch eggs, and in the same way. There is this difference, however, between the eggs of the pike perch and those of the sturgeon, that the shell of the pike perch egg is very hard comparatively, and the shell of the sturgeon egg is thin and soft.

Some of the sturgeon fry hatched at the United States Hatchery on the Missisquoi River this spring were brought safely to Cape Vincent Station—the first lake sturgeon fry, I think, that were ever hatched under the auspices of the United States Fish Commission.

As to the question whether sturgeon eggs can be taken, impregnated and hatched artificially, I should say that great pains must be taken to capture them properly and to confine them properly. In fact, the preparation for this part of the work must be very elaborate. If this is not done, lake sturgeon hatching will be a failure, but if proper attention is given to these points, I am convinced that lake sturgeon hatching will be a success, at least wherever the parent fish can be found restricted in their movements to a small area, as, for instance, the Missisquoi River.

Allow me to add in closing, that for most of the information acquired this spring in regard to the sturgeon, I am indebted to the persevering efforts and keen observation of Mr. Myron Green, and to the accommodating and liberal spirit of the river fishermen, without which we should have accomplished nothing.

DISCUSSION OF PAPER OF MR. STONE.

The President: I will say in connection with this that for years it has been the custom of fishermen to spear the sturgeon on the Missisquoi River at Swanton just below a bridge. They have their spear attached to a cord and will throw it from the bridge above, some 20 or 30 feet, striking a sturgeon and hauling it in over the bridge, and the eggs coming from the sturgeon so freely that they covered the bridge. The authorities were compelled to stop the fishing in this way because the bridge was smeared with sturgeon eggs. It was the main passageway in the village and they actually stopped the sturgeon fishing because they wanted to avoid the stench from the eggs. We have never realized they were a valuable fish, and the fishermen using seines on the lake for pike do not want to protect them because the large fish weighing 150 pounds or so will break their seines. The last Legislature passed an act allowing them to take sturgeon with gill nets.

I received about the time this sturgeon work was being carried on, a photograph from Mr. Green, who did this work, and he had two sturgeon placed in one of their jackets for stripping. The one cut open is merely to show the spawn; this will give you a view of the lake sturgeon. The fishermen sell the spawn for about 75 cents a pound.

Mr. Nevin: I would say, Mr. President, that at Lake Winnebago the sturgeon came in a great big school last year about the fore part of June, two or three thousand of them, and deposited their eggs, making the water appear a milky white. This year I laid for them about the 10th of June at the same point, but no fish showed up there.

Mr. Dickerson: Isn't there a difference between the sturgeon you spoke of as being caught on the rocks and our sturgeon?

The President: I suppose there is; yours are the lake sturgeon.

Mr. Dickerson: Not more than twenty years ago the Indians used to come into Detroit with wagon loads of sturgeon,

piled on like cord-wood, and you could buy them for from 50 cents to a dollar apiece. The Indians caught them by running a line between two stakes, attaching to this line a number of smaller lines reaching to the bottom and provided with hooks, and the sturgeon, while rolling on the bottom, were caught on these hooks. The Indians sold them about as cheap as you could buy wood. I have seen them sold as low as 50 cents apiece, but to-day they are the most valuable fish we have.

Mr. Clark: I wish to correct a statement that Mr. Stone makes. He says this is the only record of the United States Fish Commission doing anything with the sturgeon. Mr. Ravenel, I think, will recall the experiments that were conducted in the '80's or early '90's, on the Detroit River, by the United States Fish Commission. The results of the experiments we conducted at that time are on file at the Washington office. Although our success was not marked, we succeeded in getting sturgeon eggs and in hatching the fry. The eggs were taken also from the Detroit River to the Northville Hatchery and hatched, and we undertook to raise them, but were not successful.

Mr. Ravenel: Mr. Clark is, of course, strictly correct in his statement. In addition to that, sturgeon eggs were taken and hatched by Prof. Jno. A. Ryder and Bashford Dean at Delaware City, Del.

The President: That is a salt water fish.

Mr. Ravenel: All of the work with the sturgeon has been on a very small scale. There is no subject in fish culture, excepting the lobster, that we have given more time and thought to in the last few years. The sturgeon fisheries, from being very important on the Atlantic coast and Great Lakes, have dwindled to practically nothing. Two years ago, after a personal investigation on the Delaware River, we established a station at Delaware City, where about 500 nets are fished over an area of 50 square miles. At that time there were several thousand sturgeon caught, the eggs of one of which brought $84, to give you an idea of their value. We found spawners or spent fish but once or twice in the entire time. I only hope Mr. Stone's pre-

dictions will be verified, but I must confess to being skeptical. If it is true that they discharge their eggs because they are held in the nets, that makes the work simple, but if that is true, why do not the fishermen catch hundreds of spent fish. I think that the fishermen capture possibly a dozen or two spent fish near Delaware City in an entire season, where there are not less than a thousand nets; possibly that is an exaggeration—I will say five hundred nets, but more sturgeon are caught there than anywhere else in the country.

As far as hatching the eggs of the sturgeon is concerned, we need not worry about that. We can hatch the eggs of any fish just as we hatch the eggs of the grayling or trout, in jars and on trays. If we can find a place where sturgeon spawn, we will guarantee next year to go there and propagate them. We are prepared to do more for the sturgeon than anything else except the lobster, but this spring we were unable to provide money for the work.

Mr. Dickerson: Have you ever made any effort at Lake Erie?

Mr. Ravenel: No. Dr. Henshall, I think, experimented on some river in Ohio and he found but one ripe fish; that has been about the experience of everyone. Unfortunately for us the fishermen have begun to use the ripe spawn for caviare.

Mr. Clark: I would say that our work was on two lines—one to find ripe sturgeon when caught, and the other to try penning them, as with the whitefish. We only found what might be called spent fish; that is, we would get a few eggs from each, I can't tell the number, but the penning of the sturgeon in any plan that we pursued was not a success.

Mr. Ravenel: There is no difficulty in penning the sturgeon; the trouble is in getting them so nearly ripe that we can afford to hold them. We have held them for months, but got no results. The sturgeon is the easiest fish to hold in the world; they tie a rope to their snout and hitch them to anything.

Mr. Clark: The trouble is in holding them and have the spawn develop. They will hold their eggs until doomsday, I guess.

Mr. Ravenel: In other words, to have the sturgeon when ripe.

The President: I don't understand why Mr. Stone didn't get more sturgeon on the lake. I will tell you why he made the failure last year, was that he didn't go to the river until the sturgeon had gone up and come back. The first he got word of it the sturgeon were returning from the Missiquoi river. They go up this same river every year to spawn.

Mr. Ravenel: Those that he caught had spawned.

The President: Well, they had some spawn in them, but my inference is that those fish had deposited most of their spawn and gone back. We can name you within two weeks of the time that the sturgeon will go into the Missiquoi river; also the Winooski river, flowing into Lake Champlain. There won't be many of them but will weigh from 50 to 200 pounds.

The Secretary: I think one reason why they thought some of those fish were spent is, that sturgeon probably spawn but once in two years. I am satisfied that some of the rainbow trout at our Paris station spawn but once in two years, and the Atlantic salmon are said to spawn only once in two years. Last year a scientist from the University of Michigan made some experiments with sturgeon on the south side of Lake St. Clair, near the head of the Detroit river. He was there for weeks, but had little or no success in taking eggs and fertilizing them; and while he did not come out and say that they spawned but once in two years, he intimated to me that this was quite possible, if not probable.

In 1893, the Michigan Fish Commission hatched upwards of 400,000 sturgeon, and in 1894 over 100,000. One of the difficulties we met was that the sexes did not run together to any extent; the catch at any given time was either nearly all males or nearly all females. At one point on the river a seine fishery was run by private parties, who held the sturgeon in crates for a day or two—none longer than two days. I distinctly remember on one occasion of a number of ripe females being taken from the crates, the spawn running out freely as the fish were dragged along over the dock, but there wasn't a single male on hand to fertilize them with.

Mr. Ravenel: I rise to ask why you say the rainbow trout only spawns once in two years? At our Wytheville station we have one that has spawned nine successive seasons. We have a record of the fish, its weight and the number of eggs, and I wish to say that our rainbow trout spawn every year.

The Secretary: I do not claim that it is a general rule for rainbows to spawn only once in two years, but our foreman at Paris states positively that some of our rainbows that have spawned before did not mature any spawn this year.

THE SPAWNING HABITS OF THE LARGE-MOUTH BLACK BASS IN THE SOUTH.

BY J. BAYARD LAMKIN, BULLOCHVILLE, GA.

Under direction of Mr. J. J. Stranahan, Superintendent of Cold Springs, Ga., U. S. Fish Commission Station, we have made numerous observations and experiments, pertaining to the eggs and culture of the large-mouth black bass, some of which have proven very satisfactory and beneficial.

Throughout the whole spawning season, with but very few exceptions, we have been favored by clear water, which has enabled us to make more thorough observations than is possible in waters usually inhabited by the large-mouth black bass. The bass commenced to clear the gravel nests about the 1st of April, when the water in the ponds was 56° F., mean temperature. New beds were noticed each day, but no indications of spawning were noted until the 9th of April, when the temperature of the ponds had risen to 66 degrees. In the afternoon of the 9th, two bass were noticed on a nest, but it is not definitely known when the spawning was done, as a heavy rain on the 10th and 11th roiled the ponds to such an extent that observations could not be made until the 13th, when eggs were noticed on two nests. On the following day these eggs had, to all appearances, disappeared. New nests were discovered almost daily and the eggs disappeared, as the others, in from two to three days. On the 22nd of April, young fish were seen on and over the first two nests, which were first seen on the 13th, when the temperature was 61 degrees. These eggs were undoubtedly hatched on the night of the 13th, or the morning of the 14th, as will be shown later. It continued the same with all nests, that the eggs would disappear in two or three days and the fry show up in from six to eight days thereafter, depending altogether on the temperature of the water, and, I think, the amount of sunlight has something to do with the time.

Repeated experiments were made to test the period of incubation and raising of the fry from the nest, which all proved, without the shadow of a doubt, that the eggs hatch in from 48 to 72 hours after they are deposited, and that the fry raise from the nest in from six to eight days after they are hatched. These experiments were made by removing a few of the eggs from a nest with a rubber tube and placing them in a tin-pan or pail. The vessel containing the eggs was kept in fresh water at the head of one of the ponds, where it was deep enough to allow the current to circulate over it. At the same time that the eggs disappeared in the ponds it was noticed that the ones in the pans would be hatched, though it was very difficult to see them, even in the pans, without careful inspection, as they are almost, if not entirely, without color. To prove this more thoroughly, a rubber tube was placed in the nest, from which the eggs were taken to make the experiment, and fry were sucked up from the bottom, where none could be seen with the naked eye. The fry were apparently of the same age as the ones in the pan, as was indicated by an examination under the microscope.

A fact which surprised us more than anything else is that the bass spawn several times during the season. We observed early in the season that we had more nests with eggs on them than we had both male and female bass, and by the 15th of July the number had increased to about twice that. In all the ponds we only had 28 adult fish, while up to this time we have seen eggs on 57 nests, and the fish are still spawning. We know absolutely that one large male bass fathered eight different nests of eggs from April 9th to July 4th. He was the largest male bass we had and was marked by a couple of splits in his tail, which enabled us to identify him readily. On one occasion he was seen taking care of a large brood of fry and a nest of eggs at the same time.

We noticed that the principal time of spawning is in the afternoon, usually, we think, with a low barometer, as they spawned, almost invariably, just before a thunder shower. On several occasions a male was seen to have two females on the nest with him at the same time, and, as a rule, this proved disastrous to the eggs.

They were always more or less scattered about, sometimes covering several square feet of bottom.

It was soon noticed by Mr. Stranahan that the bass liked the roots of plants, or some sort of fibre, to spawn on much better than the gravel or natural bottom. A number of artificial nests, composed of cement, in the shape of a dinner plate or saucer about 16 inches in diameter, and covered with a thin layer of Spanish moss, the moss pressed into the bottom of the nest while in a plastic state, were made and placed in the ponds. The bass always selected these in preference to the gravel beds, or natural bottom. It was demonstrated, too, that these artificial nests are better for the bass to deposit their eggs on, for three reasons, as follows:

(1) The fibre affords more surface to the square inch than gravel or clay.

(2) It holds the eggs more securely.

(3) The eggs are freer from sediment than they would be on gravel or clay.

The plan of removing the eggs or fry from one pond to another by means of the artificial nest has not been thoroughly settled, but we feel satisfied that if so desired the fry can be removed after hatching much more easily than would be possible from a gravel or clay nest. In fact, it would not be necessary to wait for the eggs to hatch during good weather, when the ponds are clear. However, if the conditions are not just right, it is best to leave the eggs with the parent fish until after they are hatched, when the fry can be removed by simply lifting the nest from one pond and placing it in another. This prevents the necessity of netting very young fry.

It is much better not to have the fibre very thick on the artificial nests—merely enough to hold the eggs and not entangle the fry is all that is necessary. There is no question about the bass preferring the fibre to gravel or clay. On one occasion we placed an artificial nest in one of the ponds at 2:00 o'clock p. m. and at 2:05 a male bass was on it cleaning it off, although there were a number of gravel and clay beds in the pond.

DISCUSSION OF MR. LAMKIN'S PAPER.

The Secretary: Mr. President, I want to say that the experience they had at this station, regarding the character of the spawning beds selected, corresponds practically with our experience this spring. We have one pond for big mouth bass, and a portion of it is weedy and grassy and in another portion we placed artificial nests with a gravel bottom. The big mouth bass would not spawn on the gravel-bottom nests nor work on them, spawning only in weedy or rooty places.

The President: I will say in connection with the bass in Lake Champlain that the large mouth bass selects the reedy and swampy land for spawning. They select the rivers for the purpose of spawning also, and the small mouth bass select the gravel beds, very similar to the trout.

Mr. Thompson: I wish to say that at the United States Fish Commission station, Manchester, Iowa, the large mouth bass don't select gravel or even clay. We built a few artificial nests in the pond but none of them were occupied. They were placed about ten feet away from the shore. Those bass came up practically right on shore, and spawned under the overhanging grass, which protected them; they selected the soft, muddy bottom, where there was aquatic growth to hide them from observation.

The Secretary: Mr. Lamkin's experience seems to differ from ours in one respect. He speaks of one male having two females on a nest at the same time. It is a very common thing for several male bass to be after one female, but the competition for favors seems to be between the males exclusively; the reverse of that we have never seen.

Mr. Ravenel: The spawning of the bass on gravel, or mud, or clay, is something that has attracted attention at the various stations, and it seems to be largely a question of locality. In Missouri the large mouth bass invariably spawn on gravel; in the Mississippi River Valley they are utterly indifferent to gravel, they go on the mud or clay; in Texas we put gravel in the ponds and in no case did they accept it, but deposited their eggs on the

bottom of the pond. In Georgia, where the opportunities for observation are exceptionally fine, the water being clear and the growth not sufficient to obstruct the vision, they spawn on the bare earth, and this year Mr. Stranahan found that these artificial nests were acceptable. With the small mouth bass we have had little or no experience. If anyone can give us any information on raising black bass we would like to have them do so. People ask for a million bass when there are not a million raised artificially in the country.

The President: Do you raise your bass to fingerlings?

Mr. Ravenel: Always.

The President: How many do you raise?

Mr. Ravenel: 250,000 to 300,000.

The President: Do you estimate them?

Mr. Ravenel: Never, all distributions are made by measurement or by actual count.

The President: Any further discussion about the bass?

Mr. Thompson: I would like to ask Mr. Ravenel what has been the percentage of rearing of those that have been put in the troughs?

Mr. Ravenel: In some cases we have had splendid results. We have raised 12,000 out of 15,000. Of course trough raising of bass amounts to very little. We raise them in nursery ponds. Mr. Leary conducted a number of experiments in which he showed very conclusively that it is better not to move the bass too soon from the rearing ponds; it is better to wait until they become an inch long anyway.

The President: I would like to ask Mr. Ravenel if he has ever had any experience in determining the relative growth of the big mouth bass and small mouth bass?

Mr. Ravenel: Yes, in Washington, and there was very little difference up to October. We raised a large number of the big mouth.

Mr. Thompson: I would say that I placed a few large mouth bass in a pond in which there were no other fish except

pumpkinseeds, as we call them, and in 15 months I caught come of those bass and they weighed a pound apiece.

Mr. Ravenel: That is not surprising, the large mouth bass are rapid growers.

The President: How much do you say?

Mr. Thompson: They weighed a good solid pound.

Mr. Ravenel: In Texas the bass spawn in the fore part of March, and we commence the distribution in April, and before we get through distributing in June we are delivering fish that are 3 or 4 inches long.

Mr. Hurlburt: Two years ago, Mr. Ravenel, you sent me a can of 500 small mouth black bass and they were all sizes.

Mr. Ravenel: That is so.

The President: I will inquire of Mr. Ravenel if he has had as much success in propagating the small mouth bass as the large mouth?

Mr. Ravenel: The big mouth bass are better adapted to pond culture than the small mouth. The Potomac River, from which we get our water supply, is one of the best bass streams in the United States, and in the last 10 years we have introduced the large mouths so that they range over about 60 miles of the river.

The Secretary: I hardly agree with Mr. Ravenel, when he says that the big mouth bass are better adapted to pond culture than the small mouth bass.

Mr. Ravenel: I should have qualified that as to the Great Lake section.

The Secretary: We have about 300 stock fish in our breeding ponds and each pond is provided with gravel nests. At the first spawning there were 50 nests occupied; out of those 50, 44 were good and the others were worthless. From those 44 nests we took something over a quarter of a million fry. Heretofore we have fed the fish on liver and they didn't take very kindly to it, the result being that at spawning time the fish were ravenous and hungry, and the others fought and drove them away and destroyed the eggs, and even where they spawned un-

molested the eggs were blighted. Our foreman, Mr. Lydell, began last year feeding the fish on minnows, and gave them all they would eat, and gave them all they wanted again this spring, and as a result when they began to spawn this year there was no fighting; they paired off and spawned unmolested, and as a consequence 44 out of 50 beds were productive, and we think that is the secret—they must be fed on fish food.

The President: How large are your stock ponds?

The Secretary: Well, some are irregular in size, but those of a regular size are about 80 feet long and 40 feet wide.

The President How deep?

The Secretary: About five feet in the center. We place the spawning boxes in 18 inches of water.

The President: How many bass in that space?

The Secretary: Different numbers, from 30 to 50.

The President: You mean about 20 females?

The Secretary: Yes, we generally divide them up as nearly equal as we can.

Mr. Ravenel: Our methods are practically the same, we never feed on liver, always on chopped fish or live fish.

To refer again to the despised carp, the solution of raising bass food is the carp. We feed our bass every spring from 500,000 to a million young carp.

We have never had any trouble in the bass occupying the same nests. The spawning area of the pond is divided off into departments, and a dozen pair of bass are put in each department. I want to ask Mr. Bower how he arrived at that estimate of a quarter of a million bass fry?

The Secretary: We allow the male fish to guard the nest until after the fish have hatched, and just a day or two before the fry are ready to rise we set a screen around each bed—we call it a fry retainer—it is a band-iron frame covered with cheese cloth. In a few days, depending on the temperature of the water, the fry will rise; we then take them out and count a part of the product of each bed, enough so we know our estimates are very close. We have taken as high as 10,000 from a single bed,

and as low as 2,000 or 3,000. But it is just as easy to arrive at the number, approximately, as it is of trout or any other fish that are estimated from a partial actual count. I don't know of any better way than that, unless you count them all. We have very little guess work about it; we know positively that our estimate is very nearly correct, as nearly so as any careful estimate can be.

Mr. Clark: Mr. President, I didn't propose to take any part in the bass discussion, but Mr. Bower made one statement that I want to correct a little. He says, it is just as easy to arrive at the number of bass as it is of trout or whitefish. Now, with the trout we have a chance to handle the eggs and know exactly just how many eggs we have just previous to hatching; that is something you cannot do with the bass. Now, if we have a box of 60,000 trout eggs, we know that usually we are going to have 58,000 fry anyway.

The Secretary: That is all very true, I will admit that, but Mr. Clark will agree with me, I think, that there is far more guess work telling the number of whitefish after they are hatched than there is with bass. Now, we hatch quite a number of bass, and while it isn't practical to count them all, we count a sufficient number so that we know our figures are very nearly correct.

The President: Any more remarks on the bass? If not, I would like to tell you our experience in Vermont. A number of years ago, perhaps fifteen, a bass fad swept through New England. The State Commissioners up there and the United States Commission both had the small mouth bass and put them into every pond they could find; they put them into our trout ponds and into our large and small ponds. When they were put into the small ponds they would clean out the perch and bullheads. I have one pond in mind of about fifteen acres that was full of bullheads or hornpouts and perch, and the bass were introduced there and they cleaned out every fish in that pond. To-day the bass seem to thrive there to a certain extent, that is, propagate there very rapidly. We use that pond as a source of supply for

supplying others. We seine that lake every year and take out bass running from three inches in length to a pound in weight, and that is the only place where we do any work in introducing them to other waters, but if we could go back fifteen years we would not let a bass come into the State. Our waters were originally all trout waters. In Lake Champlain we want all the bass we can get, but many of our lakes have been ruined by the bass. In those lakes they won't bite, they won't take our bait. There are ponds where we know these bass weigh six or eight pounds and we cannot induce them to take any bait at any season of the year.

The Secretary: I entirely agree with Mr. Titcomb that black bass should never be introduced in any water containing salmon or brook trout or any fish of that grade. Some years ago I was stationed at Green Lake, Maine. Not long before that someone had put a supply of small-mouth bass in that lake and they were becoming quite numerous, although the lake was already well stocked with landlocked salmon. The residents there were as much opposed to the bass as some localities are to the carp.

Another point I want to speak of. Someone spoke about food for the fish in the ponds. Now, in addition to the minnows that we supply them with, we also hatch a great many suckers; all the ponds are simply alive with sucker fry. We also introduce what is known as the corixa, the young corixa making splendid food for the young bass. We allow the center of the pond to become filled with vegetation and the water to get pretty warm so there will be plenty of animalcula for the fry to feed upon. In this way, of course, considerable food for the old and young is provided, besides that brought in from outside sources. I believe, as Mr. Ravenel says, the solution of supplying food for the bass is in the breeding of carp expressly for food.

The President: Any other remarks on the bass.

Dr. James: If it would be in order for me to make a remark on the carp just here—I take more or less interest in that subject—I want to say that I don't want to be too hard on that kind

of fish. I believe the whole trouble is in the manner in which it is cooked and prepared for the table. I think that the carp received a "black eye," as we say, simply because the people did not know how to prepare it, and I believe that the New Yorkers get a little ahead of us Philadelphians in cooking this fish, and that the reason we do not like the carp may be because we do not know how to cook it, for now we find it at many places; as soon as they find out how to cook it they all want the carp. Then there is another thing; I see here by our debate that the carp is a good food for other fish, that the spawn is good for other fish to feed upon, and if it has no other use I am going to thank the United States Commission for introducing the carp. I am in favor of the carp at the present time.

BROOK TROUT FRY; A RESUME OF METHODS.

W. T. THOMPSON, NASHUA, N. H.

Much has been said regarding the hatching and care of brook trout fry, and so well said; hence it is not with the expectation of advancing any strikingly new thoughts that this paper is presented, but rather with the view of promoting discussion and thus incidentally securing for the benefit of the individual the accumulated and composite experience of the entire membership of this society. A re-threshing of the old straw may still bring to light some few golden grains hitherto overlooked. I do not anticipate that my ideas will meet with your unanimous approval. Indeed, should they not be criticised and better methods suggested, I should fail of accomplishing my purpose, namely, exchange of experiences—not successes alone, but failures as well, with the reasons therefor. Along this rock-bound, storm-swept, dangerous New England coast, a wise government has, in addition to charting the seas, placed buoys and lighthouses to mark what? The smooth sailing? No, rather the rocks and reefs on which many a good ship has been wrecked. Is it not the duty of this Society to so chart the fish-cultural sea, mark the rocks where lay danger, help others to avoid them and sail safely into the harbor of success?

I take it that each of you has had a greater or lesser experience along this line, many of you were amongst the pioneers, so I shall endeavor throughout to make my remarks suggestive rather than exhaustive.

Pond and lake, brook and river, spring and driven well have each, in different localities, served well the fish-culturist's purpose. As to temperature, 35 to 55 or even 60 has answered, the mean and not the extreme is advocated. In the north it should be low enough to so retard development that food will be abundant in the waters by the time the fast crowding quarters make

planting a necessity. For ease of manipulation, freedom from the trouble and worry of snow and ice, leaves and freshets, with soil and debris laden waters, the interminable work with screens, the danger of washouts and the various other unenumerated hindrances; give me, if you please, spring water or water from a driven well, temperature 45 to 50, sufficient fall for aeration and yet with troughs at comfortable working height.

The spawn, shall it be from wild or domesticated fish? I believe it cannot be gainsaid that eggs from the latter—at their best—with proper and sufficient food, good range and a moderately cool temperature, are larger and produce larger fry, which, with an inheritance one generation, at least, removed from the wild state, are more easily handled and more susceptible to the enforced artificial conditions awaiting them in their life of captivity. On the other hand, and may I not say, in the majority of cases, improper feeding, either a lack or an excess as to quantity, insufficient as to variety, and, as we all know, during the hot summer months at least, too often most offensively deficient as to quality; the lack of exercise owing to restricted range and being freed from the necessity of "hustling" for a living, all conspire to sap the constitution of the parent and tend to produce fry with but little inherent vigor and vitality, and especially so when coupled with generations of inbreeding. Under the usual conditions incident to captivity, I believe I am perfectly justified in stating that the concensus of opinion is largely in favor of spawn from wild fish as being more uniformly satisfactory.

Thorough and continuous aeration is the great essential in hatching. A given quantity of water flowing in to a trough will renew itself twice as frequently when kept at a depth of three inches than if kept at six inches, so we drop in our trough a three-inch galvanized dam for the present. The tail screen is the greatest death trap ever placed in a trough, but we cannot do without it; let us lessen its murderous suction power by extending the distance from the Niagara of the dam; make it, say, four inches at least. Much has been said of the additional aeration

secured by the use of the horizontal screen. Possibly the simple wooden frame wire hatching tray is the form most generally used. We wish to extract the life-giving virtue from all the water, and not of one strata only, so we peg our tray in position at the greatest angle possible while still retaining the current both above and below it.

Many of the nearly hatched embryo have their vitality so weakened by the diversion or impeding of the free flow of the current caused by the settling of the shells on them that they die "aborning," or at least before the sac is absorbed.

Clogged screens at any time, and more especially during the hatching period and early life of the fry, is wilful fish slaughter. Absolute cleanliness should be the motto at all times.

In theory, we have a free and equal flow of water throughout the entire trough. How is it in practice? In your daily round, have you not some morning found glazed eyes where but yesterday all was well? It may be a little group here and there, or it may be a streak running from one end of the tray to the other. Theory will not give them back life. Investigation may or may not fix the cause. Why do so many embryo fail to break their shells? They were apparently strong and well developed up to or almost to the hatching period. There they are, there they remain. Living or dead, which? It is possible a few may still have sufficient vitality to break forth into a brief weak and stunted existence; but is it not a fact that there remains on the trays at the close of the proper hatching period, in almost every lot, an uncomfortably large number of eggs of this description? If this is a fact, why? Can it not be overcome? The cause, I firmly believe to be deficient, or, rather, imperfect aereation arising through some diversion or obstruction of the current. Theory and fact have conflicted ere this. You may amuse yourself with theory if so disposed, but facts such as these are too uncomfortably assertive for any such pastime. The cure, more perfect apparatus, giving more thorough, perfect and reliable current, better aeration; result, stronger fry and more of them. From personal experience at the Nashua Station, the salmon basket of the Pacific coast, somewhat modified as to size, would

seem to be the coming device. Have you tried it? No? Do not fail to do so this fall. Old troughs can easily be equipped for the purpose. With three gallons of water, temperature 48 degrees, we hatched 25,000 eggs in a single basket one foot square with infinitely better results than we secured on trays 1x2 feet, carrying only one-third the number of eggs per tray. Hatching capacity is marvelously increased.

Next we turn our attention to the avoidance of the danger of suffocation during the sac stage. Fry will pile up on each other. If we are carrying them in large numbers, three or four subdivisions of the trough by the use of perforated zincs will be of material assistance. Right here let me mention a weakness of the ordinary trough that is not obviated by the use of the horizontal screen. Our restless little friends will persist in scrambling to the head of the trough, gather in dangerous numbers in the eddies in the corners back of where the supply falls; if you are not on your guard, some day you may be surprised to find a few thousand ashy-gray corpses floating around. A perpendicular screen near the head of the trough just below the inflow will keep them from this danger. During this stage the fry remain on the bottom, drawing only from the lower strata of water. Are you still crowded for room? Do you wish to double your carrying capacity? Then use a retaining, or fry basket, in each subdivision; it works somewhat on the same principle as the double-decked hog and sheep-shipping cars we are familiar with. Thus the problem is easily and safely solved. Using only three gallons of water per minute in a trough 12 feet long and 1 foot wide, subdivided by perforated zincs into four compartments, and using baskets in but two of the divisions, we successfully carried 65,000 fry to the feeding stage; in fact, actually taught them to feed. The wooden frame of the basket resting on the sides of the trough supports the bottom about one and one-half inches above the bottom of the trough. Had we used a basket in each compartment we could have increased the fry to 80,000. It is a fact that more fish can be carried in the baskets than in the trough proper, since the bottom fish in the former cannot have their air shut off by those above. This and the hatching basket, as adapted to trout work,

are the result of the lifelong experience of Supt. Waldo F. Hubbard, of the U. S. F. C., with the Pacific salmon.

Who knows the cause of the ever-present blue sac? Have you a theory?

Remember, that all fry are restless, inquisitive little beings, poking their noses in wherever they find a hole sufficiently large. Isn't it surprising how small that sufficiently large can be?

All our authorities seem to presuppose that the fry are free swimmers, "able to balance themselves easily and gracefully in the water," and ready to rise and strike at minute pieces of cork, or other floating substances, when ready for food. I wish to state most emphatically that such is not the case with brook trout fry.

On behalf of this Society, on behalf of my brother fish-culturists who may also be led astray by this false doctrine, on behalf of the neglected and suffering fry, I wish to build my lighthouse right here. I would build the foundation so broad as to entirely cover this rock of danger. I would have the light so bright and far-reaching as to shine out wherever a brook trout is propagated. You will kindly remember that I am not speaking now of trout in general, but the brook trout in particular. Much of the complaint of failure to get certain lots to feed, much of the thin snakelike appearance so often seen in the troughs in the early feeding period, and much of the death rate at this time, are directly traceable to too strict adherence to this teaching. Simply because the brook trout is generally known as a surface feeder, it is assumed that he must necessarily be such from the very beginning. I wish again to state most emphatically that while such may be the case frequently from necessity, by choice, or, to put it more correctly, by nature, brook trout fry are bottom feeders for a brief period at first—in other words, they feed before they can swim.

Let us consider the philosophy of the matter. The Creator packs a month's rations in the little fellows knapsack, tells him he must forage on the country for subsistence hereafter. In the wild state do you suppose he waits until this supply is exhausted before making an effort to skirmish for himself? I ask you, is it a reasonable supposition that the change from absorption to feeding and

functional action of the organs is sudden and radical rather than slow and gradual? No progressive breeder in these modern days ever thinks of waiting till weaning time before accustoming his young stock to the change of food. The transition is made so gradual that the sensitive digestive organs do not resent it, the change from milk to grain is accomplished almost imperceptibly, not an ounce of flesh is lost, not for a day is the growth checked from infancy to maturity. This is the secret of the wonderful development of herds and flocks of to-day. It is true that in days gone by the farmer, in his wisdom, ran things differently. A direct transition from absorption to digestion is much more radical and dangerous than from milk to grain. Which are we, farmers or breeders?

Let us watch our newly-hatched fry. At first his only instinct is to hide, to burrow somewhere out of harm's way; nature's provision is all sufficient for the present. Some weeks have passed, sac two-thirds to three-quarters gone, then we note a change. At nature's changing call, segregation begins, the older and stronger fish draw apart; they are no longer a component part of the burrowing mass, but take up an independent existence as individuals. Though unable to swim, our young alevin can and does move around on the bottom. Why? Knapsack getting light, he is now on the lookout for minute animalcule. Let us test the matter. We dip our feather in the food, specially prepared, infinitesimally fine, draw it lightly over the surface of the water, the minute particles sink very slowly, one inch, two inches, three inches, and still not a strike; as surface feeders they are evidently not ready. But wait a moment! Just watch that big fellow on the outer edge there. See the glitter of his eyes, his whole body seems tremulous with excitement. The particle slowly approaches, only an inch, only a half inch away. A whisk of the tail, a quick dart upward, and one little fellow has found what his nature craved, one fish has learned to eat. He settles back to the bottom; then, at the new and strange sensation as the food passes into the stomach, he leaps and darts about for a few seconds, seemingly in a very paroxysm of delight. That atom was the lever that threw into gear the whole machinery of digestion and assimilation. He has found

his vocation in life, he lives but to eat. From that moment he is as brave, as cruel and as daring a little pirate as ever sailed the waters. As bottom feeders, they *are* ready. Continue feeding not less than six times per day. Nature and example will soon teach the others. In three or four days, assuming the fry are of an age, they will be feeding quite generally; but the amount consumed per trough will be very small. Requisition is still being made on the knapsack. In a week's time, perhaps, a few of the stronger fish will begin to rise a little from the bottom; in two weeks all will be up—big, broad, lusty fellows as ever delighted the eye, the equal of fish a month older fed by the usual methods, much more even in appearance and with infinitely greater possibilities for future growth and early maturity. Feed them generously, overfeeding for fish under a year is but a bugaboo; feast your soul on his splendid growth, revel in anticipation of some brother angler's delight when, grown to a two-pounder, the little fellow we saw take his first bite shall strike his fly and give him the strongest, gamiest battle of his life.

Much of the food fed at this time is entirely too coarse for the fry's delicate digestive organs. We find that grinding it three times through a one-sixteenth inch plate and then running it through a wire screen 24 strands to the inch makes it very acceptable in size. A little of the food will, of course, sink to the bottom; feathering at this stage would be tedious as well as injurious. It is not necessary, however, until the fish rise. Take a fine mesh net, a little narrower than the trough, draw it along the surface of the water; the current will raise the food as well as some of the fry. The latter, being heavier, will soon sink; reverse your net and you will get most of the waste food. After a few attempts, you will soon become expert in this simple and harmless method of trough cleaning.

At the beginning of the feeding, take out the small dam in use heretofore and substitute one 4, 5 or 6 inches deep, as your trough may permit. It serves two purposes, additional range for the fast spreading and raising multitude and greater opportunity to secure the food while in suspension.

Two rather serious objections may still be urged against the horizontal screen, even in connection with the head screen. The stronger fry so crowd against it as to make it rather difficult to place feed before them; then there seems to be an eddy that collects and retains food and other filth which should be carried by the current in conjunction with the constant movement of the fish to the lower end of the trough. We have therefore abandoned it in favor of the head dam. Aereation seems improved. A delightful current is created thereby, which can be regulated by the height of the dam and volume of water. The little fellows thoroughly enjoy the pleasure of breasting it. A light wire of suitable height on top of the dam prevents their shooting the falls as they grow older.

Take special care of the weak, the strong will look out for themselves. Frequent thinning of the trough is necessary. The weaklings naturally gravitate to the lower end. Take them out of the various troughs and place them by themselves. Special care and extra feed will soon bring them out.

Occasionally, and without giving the matter due consideration, people characterize our great trout breeding establishments as mere toys, playthings for the benefit of the rich or idle, point to the unanswerable statistics of the marine, the salmon and Great Lakes hatcheries and ask triumphantly, where are yours? There are some things in this world whose value cannot be measured even in coin of the realm. The statistics of the brook trout are graven on the heart.

In the Koran there is a passage reading thus: "If a man have two loaves let him sell one and buy a lily; bread feedeth the body, but the lily is food for the soul." So it is. In pursuit of the brook trout, in wandering mid field and forest, by shady brook and rushing mountain torrent, in communion with nature in her wilder, grander moods, the weary souls of countless thousands have been refreshed and strengthened into truer, better and nobler lives.

DISCUSSION OF MR. THOMPSON'S PAPER.

Mr. Thompson: I might say that these zincs are not a fair sample; the regular zincs are perforated. In connection with the salmon hatching basket and the retaining basket, I might say that the Harrington & King Perforating Co., of Chicago, can make them entirely out of zinc. The price I believe is twelve cents a square foot.

Mr. Hurlbut: It would be a good deal of work to take care of a box fitted up that way.

Mr. Thompson: Oh, I don't know. You understand, Mr. Hurlbut, the use of these compartments is only during the sac stage. We carried 65,000 in a trough twelve feet long, and we could have raised the amount to 80,000 if we had had two more boxes in use.

Mr. Hurlbut: I was down to Cold Spring hatchery this spring and I saw something there I never saw before. I saw a trough full of fry, and on top of the water were a number of floating boxes, also filled with fry. The superintendent told me they had over six million brook trout fry in the hatchery, besides some thousands of lake trout fry. That was all very well for them but of no use to the commercial hatcheries.

Mr. Thompson: I believe I heard Mr. Handy remark that there was a great deal of trouble to keep the fry from suffocating; this will prevent that. I might say in further explanation, those that are suffocated are always underneath, the others crowding over them and shutting off all the water, but it doesn't matter how deep they crowd on this, the under ones are absolutely safe. You can carry more in your trough if you use these baskets, even if you don't use the bottom at all. In other words, you can carry more in your baskets than in your trough proper.

The President: You get a circulation underneath?

Mr. Thompson: Yes.

The President: I want to ask a few questions about this. I like this fixture for using the screen without a wooden frame around it, is there any objection to that?

Mr. Hurlbut: It is better this way than the old way. In

the end there, instead of using the dam across there, they use a tube with a rubber band around it. If you want it higher you raise it up; you can have it one inch deep or higher.

Mr. Ravenel: I would like to ask Mr. Clark how many fry he carries in relatively the same space?

Mr. Clark: I have been very much interested in Mr. Thompson's paper and of course have always been interested in those models that he has shown, but I hardly think he brings them forward as new inventions, do you Mr. Thompson?

Mr. Thompson: No.

Mr. Clark: They have been in use, all of the models, for quite a number of years and are all good. Of course his system there of slides is nothing but a remodification of the Clark-Williamson box, and of the Williamson box; we are using them right along, only instead of tin ours are wood, but the plan and the whole system are practically the same. The idea of forcing the current from underneath is all right. The current in the Clark box is downward while they are hatching the eggs, but after the eggs are hatched the box is turned around and then the current is upward. Our system, as perhaps a good many of you have read, is thoroughly described in the Manual of Fish Culture, and it tells there just the number of eggs we carry on a given number of trays. Each box or compartment in the Clark-Williamson hatching trough is 19 by 10 by 12 inches, and holds 60,000 lake trout eggs, 6,000 on each of the inclosed ten trays.

The President: Carry as fry?

Mr. Clark: Carry them forward to the point where the eggs are ready to hatch, then we reduce them to 40,000 and carry them in the same space until they are hatched and until the fry are ready for distribution or feeding. In other words, we leave from these 60,000 eggs 40,000 for hatching and rearing.

The President: And carry them until just before the sac is absorbed?

Mr. Clark: Until the sac is absorbed.

Mr. Handy: I would like to ask how much water you let through the trough?

Mr. Clark: It runs up to 12 gallons and down to between 6 and 7 gallons. Any reasonable amount will do the Clark box; it is a box within a box, and the water flowing in forms an eddy and passes down through the trays and escapes through the holes in the bottom of the inside box and comes up around the sides. Now, after the eggs hatch, the box is turned around and the current then flows up through these bottom holes. Understand, the oblong wire mesh is not used at the Northville station or an other station that I have connection with, for the reason that we always hold the fry on the same tray we hatch on; we don't allow them to pass through or over the tray, for we couldn't handle the quantity we do with such a process. The floor space where we handle from twelve to fifteen million does not occupy, with the alleys, over about 28 feet—that is the length of the troughs—by about 40 feet the other way. Of course, our methods are described more perfectly in the Manual. That gives you—I think in the article on lake trout, more particularly—a full description of every point in regard to the workings of our station.

Mr. Ravenel: I only called attention to that because Mr. Stone, of Cape Vincent, has built the same thing for the brook trout. I was there a few weeks ago and saw several stacks of trays taken out. The fry were in splendid condition, the sac just absorbed, and some were shipped the next day on trips of twelve hours with practically no loss. I have forgotten the exact number on the trays, but it was the first time I had seen brook trout handled in that way and with such splendid results.

Mr. Clark: I would say further, Mr. President, in regard to the trouble which Mr. Thompson speaks of, of quite a large quantity of eggs not hatching out at the end, that we have no such experience. The only trouble that we have, with lake trout especially, is the blue sac, and we do have quite a percentage of blue sacs, but no loss of eggs after they have been thoroughly sorted; we hatch after that approximately 100 per cent.

Mr. Hurlbut: What is the cause of the blue sac? (Laughter.)

Mr. Hubbard: I would like to say a few words in regard to the basket. In taking the dead eggs from the basket, the basket being filled about half full, you just lift it up and raise it in that manner, which gives a boiling motion to the eggs and allows the dead ones to be seen.

The President: You don't do that during the delicate stage of the eggs?

Mr. Hubbard: No. Now they are not a long time in the delicate stage and you can leave them all that time without picking out the dead ones.

Mr. Ravenel: How many days would it take to eye the eggs?

Mr. Hubbard: At a temperature of 38 it would take, well, two months at least.

Mr. Ravenel: On the Pacific Coast they cover up the eggs two to four days after they are taken and they do not uncover them until the delicate stage is passed; it may vary from 15 to 30 days. The eggs become covered with a sediment, but they wash them and have very little loss.

Mr. Hubbard: I don't see much difference between the salmon and trout eggs, as to one being more difficult to handle than the other.

Mr. Ravenel: I think experiments have shown that brook trout eggs will stand transportation better than salmon eggs.

Mr. Dinsmore: We have always eyed eggs in thirty days. My experience in eyeing eggs has been that there would be about 15 days, or perhaps 20, that I would consider them critical, injurious to handle. Now, if they are left a week before you pick them over, every bad egg that you touch would fall away. If they are left 20 days without being disturbed all the eggs underneath and over a bad egg form into a ball.

Mr. Thompson: In order to further discussion along that line I would like Mr. Hubbard to state the result of an experiment that he made out on the Pacific Coast regarding leaving salmon eggs in the baskets during that period.

Mr. Hubbard: This lot of salmon eggs was picked over

after they were taken and then put in a basket and covered up for 18 days with a board and left perfectly dark. When the board was removed the top of the eggs was covered with mud, you couldn't see an egg, but as the water came up through the basket the under side of the egg was perfectly clean, and by moving the basket up and down, the mud was washed off and the eggs would be picked over. The loss wasn't near as much as in other baskets, not near as much in this basket that was covered and not disturbed.

Mr. Dinsmore: Were any of those covered with fungus?

Mr. Hubbard: There were a few, but what few stuck to the fungus didn't amount to as much as in those that had not been covered up.

The President: Any further remarks on this subject?

Mr. Clark: You seem to touch upon the delicate stage of the eggs, but I don't hear anyone say when this stage is, and that ought to be answered in some way.

The President: I would say that we collect wild trout eggs and we don't want to handle them any more than necessary after the first day. We can, but don't want to.

Mr. Clark: Some experiments were made by myself, and days and dates were given, which are now in the hands of the United States Fish Commission, and the experiments were very thorough, and we found we could handle them any time up to the eighth day as safely as after they are eyed.

Mr. Thompson: At what temperature?

Mr. Clark: A temperature of 48. I never should hesitate to move green eggs any time up to that time, but between that and up to the sixteenth and eighteenth day, I never should move them.

Mr. O'Mally: Speaking of the delicate stage, I have had some experience the past year and I find that salmon that are handled after the eighth day don't do so well as those that are left alone after the fifth day. I picked one basket right through the whole season from start to finish, each day, and it survived, but those that I picked beyond the fifth day showed the effect of

handling. Our water at that time in September was about 50 de-degrees. We have a lot of mud in our troughs, too, because the supply of water comes from a creek, and the eggs were covered with mud at the time, that is, the top, so we couldn't tell what was in the basket. They were there fifteen days before you could see the spinal column. I would suggest if anyone was going to build a basket, that instead of making it with the wooden rim they use a number eight steel wire. I would like to ask Mr. Thompson how that basket is arranged, if it goes to the bottom of the trough?

Mr. Thompson: The basket is supported on the side of the trough, and you can regulate it, that is, you can make it any depth. Of course, you don't want it to rest on the bottom. You can have it an inch or more from the bottom, as you desire.

I was going to say in relation to Mr. O'Malley's remarks, the Harrington & King Co., of Chicago, can make them of zinc; there is no rust to the perforated zinc and I think it is no more expensive and probably more durable.

Mr. O'Malley: My idea of the steel rim for the basket was to do away with that wooden apparatus to keep the basket off the bottom of the trough. In the salmon trough we use four small pegs, one for each corner.

Mr. Thompson: On the baskets?

Mr. O'Malley: No, I mean the other little cleats up on the trough, and the basket rests on each corner.

Mr. Ravenel: On the side of the trough?

Mr. O'Malley: No, on the bottom.

The President: I want to discuss with Mr. Clark a little more about the handling of green eggs. I do not agree with him. I have handled trout spawn a number of years, and we used to transport the green spawn on a few hours' run the first or second day after they were stripped. Then we adopted the plan of setting up troughs at our field station. We set up a trough in a tent sometimes and eye our eggs there. In other cases we get hold of a deserted farm house, or put up a little shanty, in one of which I eyed last fall 600,000 eggs before I took them to the hatchery at all, and we found we could get a much larger per-

centage of eyed eggs, if we took them and laid them right down in troughs in the woods and let the water flow over them there until after the eye spots have shown plainly through the shell.

Mr. Nevin: We never intend to take them out of the trough before ten days; after the tenth day we take them out but never attempt to before that.

Mr. Clark: As I am on record in an official way I cannot go back on it, and I still stick to it because I tried the experiments myself. The time and everything was accurately noted, and I was surprised at the results of some of the experiments myself. I didn't think it would be necessary to hold eggs between those times, but I wouldn't to-day any more think of having eggs turned out of the trough between the tenth to eighteenth days than I would fly. But, Mr. President, we give our experiences here, and I do this way and you that, and we have good results. Now, we are not supposed to stand up here and say we have had those results unless it is so, but what proves to be the best way in one case may not do in another.

PROPAGATION OF THE PACIFIC SALMON.

BY S. W. DOWNING, PUT-IN-BAY, OHIO.

Were I writing this article solely for the purpose of reading before this meeting, I would not presume to go into details and give a description of the manner of securing the eggs and the methods employed in hatching them, as it is taken for granted that all or at least most of the members present are familiar with this work, but for the benefit of those who may read the forthcoming account of the proceedings of this meeting who are not familiar with this work, I will give a brief description of the work as carried on at the different salmon stations where I have been located during the last three hatching seasons.

First, it is necessary to know something of the nature and habits of the fish in question. In most of the streams, and especially those extending long distances from the ocean, there are two runs of fish, the first occurring in March and April, and the other in July and August.

The fish coming into the streams in the first run go to the very head waters, reaching the spawning grounds late in July and August, where they remain until spent, and in fact until they die, for it is a fact not generally known that all the salmon that ascend the streams any distance above tide water, die soon after the eggs are deposited.

The second run enters the main streams about July or August. These do not ascend the stream to the distance as the first run, but they enter the small tributaries near the mouth of the main streams, they apparently being more mature on entering the stream, and in consequence seek a suitable place in which to deposit their eggs soon after leaving salt water.

The methods employed by the fish culturist in securing the eggs, is to first find some suitable location on either the main stream or some tributary, and throw a barrier across the slats

or pickets which are sufficiently close together to prevent the fish from passing between them, and high enough to preclude all danger of their jumping over, the lower end of course resting upon the bottom. This barrier prevents the fish from ascending the stream, and as it is their nature to push their way as far as there is water sufficient for them to swim in, and as they never cease the struggle and turn back, large numbers congregate just below the barrier, which is usually placed just above a deep hole where the fish lie during the ripening period before seeking the riffles and shoals upon which to spawn. Watch is then kept of the movements of the fish, and as soon as any are seen on the riffles fishing commences. The fish are taken either with a seine, or are caught in a down stream trap into which the fish are driven by going above them with a seine, and frightening them so that they make a rush down the stream and are crowded into the traps, from which they are taken and the ripe ones put into crates, where they are held for the next day's spawning. The latter method of taking the fish is preferred when the nature of the stream will admit of it. The green fish taken are always liberated, as they will not go away, and thus the fishing is continued until the spawning season is over, and practically every fish that entered the stream has been handled.

The need of carrying on this work on as large a scale as possible will be more readily understood when it is more generally known how totally lacking the salmon is in that instinct that prompts the two sexes to seek each other for the purpose of reproduction. The writer has had an excellent opportunity during three entire spawning seasons to study this trait in the salmon and never but once has he seen the two sexes together performing the functions necessary to fertilize the eggs as they are ejected by the female, and in conversing with others who have had ample opportunity for observing these fishes for years, I have never met a man who had ever seen the two sexes together at this time, as we so often see in other fishes such as the black bass, catfish, sunfishes, and many others, and for this reason it is safe to say that not one egg in one thousand is fertilized when

the fish spawn on the reefs naturally. A female will select a spot upon which to spawn, and if not disturbed will remain there, or near by, occasionally turning upon her side and with a pounding motion with her tail, and in fact with the whole body, eject a few eggs; this process is kept up at intervals of from ten minutes to half an hour or more until all her eggs have been deposited, the time consumed being from a couple of days to a week or more. The spawning always takes place in a swift current and where the bottom is gravelly, and the pounding motion spoken of loosens the gravel immediately beneath the fish; and as the current washes it from a few inches to a few feet down the stream, often a hole from one to two feet deep is thus formed, and a correspondingly large pile of gravel made just below. The eggs that have escaped are consumed by the thousands of river white fish, suckers and the several kinds of trout with which these streams abound, as the eggs and the gravel are washed down with the current together.

But where, all this time, is the male? Perhaps lying a few feet below her, or perhaps a few feet at either side, but never once approaching her. The writer has reached the conclusion that the only way in which the fertilization of the salmon egg has ever been brought about, is at those times and places where the fish are so very thick in the streams that during the hight of the spawning period, the whole waters of these small streams are completely permeated with the spermatozoa of the males; and when one realizes that each large male produces a quart or more of semen during the season, it will be readily understood that large numbers of eggs could have been, and undoubtedly were fertilized in this manner. But it will be observed that the number of eggs, or the percentage rather, that are fertilized in this manner is just in proportion to the number of fish in the stream during the spawning period, and that in the streams that but few fish enter, the percentage of eggs that are fertilized is reduced in the same ratio, and as the number of salmon entering the streams is becoming less and less each season, it becomes more imperative that the work of propagation be carried on to the fullest

extent, as it is in these small streams that formerly so many fish ascended, and where at one time the chances of fertilization were enhanced by the great amount of semen ejected by the males, and that now but few ascend, rendering the chances of natural fertilization almost to the point of nil, that the work of propagating the salmon should be carried on to the fullest extent. Every stream or tributary that will yield a million or more eggs should have a sub station, and all the eggs possible taken, hatched and the fry returned to the stream, scattering them over as much territory as possible. This, in the opinion of the writer, would be a far better method, and the results in mature fish would be much greater than to have large establishments, and turn out many millions into any one stream, as each stream or portion of it has but a limited supply of the natural food suitable for the young salmon, and all in excess of the number that will live upon the food supply must necessarily perish; and as most of these streams are in a broken country where is is almost impossible to give the fry anything like a wide distribution, they must necessarily be put out over a very small area. Thus it will be readily seen that in such instances it would be an easy matter to overstock the streams, and even if none died from starvation, some would become stunted, and never reach a normal size, besides cannibalism would be encouraged; the larger and stronger ones eating the small weak ones. It has been noticed that in the past few years the number of undersized salmon that were taken were steadily on the increase, the last esason showing a far greater number than any previous season. The only logical conclusion that the writer has been able to reach is that this is the result of overstocking the streams where the work of propagation is carried on to any extent, numbers of young fish being stunted for lack of sufficient food, and although they live to mature, they never grow to the normal size. This line of reasoning will undoubtedly be objected to by some on the ground that nearly all these undersized fish are males, but it is known that the fish of any one season's hatch do not reach maturity together, that is, a portion will return the third year, while another portion will

not return before the fourth season, and it is our opinion that the males mature, even if under size, and return with the regular run, while in the case of the female, she does not mature until after sufficient time has elapsed for the ova to mature, and thus she has one more season's growth than the male, and is consequently larger, on an average, although there are instances of very small females coming into the streams, and some have been taken and spawned that have weighed but from six to eight pounds and the eggs from them hatched and the fry seemed strong and healthy.

The writer is aware that this article is but a poor, crude affair, but hopes that the main idea, i. e., the need of more extended work in the propagation of this most valuable fish, has been made apparent.

DISCUSSION OF MR. DOWNING'S PAPER.

Mr. O'Malley: I didn't quite catch whether Mr. Downing limited the spawning of his fish to the blue-back salmon or to the Pacific salmon?

Mr. Clark: He refers to the quinnat salmon.

Mr. O'Malley: I should say that with the blue-black the male and female work together.

Mr. Hubbard: I have had considerable experience with the salmon, and I wish to say that the males do work with the females in spawning naturally. The female will work alone, but usually there will be one to three or four males just below, and when these males notice the female excluding the eggs they will rush up and deposit their fluid over them.

Mr. Ravenel: I think, Mr. Chairman, Mr. Hubbard is right. It is true of all other fishes and must be of the quinnat; but if not true, there would not be one-tenth of one per cent of the eggs deposited that would be fertilized. Extensive experiments have been made showing that the milt is absolutely fruitless after it has been in the water two or three minutes. I don't think there is any question at all but that two minutes is the dead line, and, in fact, one and one-half, I think, will not produce a 10 per cent fertilization.

Mr. Bryant: I would like to ask if the salmon dies after it deposits its eggs; they run up in such immense numbers, what becomes of them?

Mr. O'Malley: Near Baker, Washington, where the salmon die, they are disposed of by the bears eating them

Mr. Hubbard: I think it will be found in all spawning streams that after the salmon spawning season is over the river and shores are full of dead salmon, and you can smell them for a long ways. A great many of them float off and sink in the eddys, but it has been proven, I think, that they die after spawning.

The President: I will inquire if there is any exception in the salmon of the Pacific coast, any varieties that do not die after spawning?

Mr. Hubbard: Well, the steelheads do not die after spawning.

Mr. Ravenel: It has been a prolific source of discussion for a number of years, and a great many have been very skeptical about the salmon dying after depositing their spawn. Some have attributed it to the hardships they had to go through. But in Alaska, in the little mountain streams, the salmon at the headwaters are in as bad condition as those taken five hundred or a thousand miles up the Snake river. A captain of engineers was sent out and instructed to make a report on the Portland canal, and he found a little stream a quarter of a mile up in the mountains where the salmon were so weak they could hardly work their way up, and there were just as many wounded and dying salmon there as in the upper waters of the Sacramento or Columbia. It wasn't the distance they had gone, but their condition.

Dr. James: That is not a strong point, because the streams are very rapid and there is a great deal of exertion before the salmon gets up to where it wants to go. The streams flow so rapidly that the fish are swimming up for a long time, and it is easy to see how thy get exhausted—that is, from the time they enter the stream until they spawn, and that, I think, is an injury.

The President: He was proving to you that in the streams that are not any longer than from the coast out to that shore the

salmon die after spawning just as much as after swimming thousands of miles; they find that out to be a fact that they will die anyway after they spawn, whether after undergoing the hardships of leaping falls or not.

Dr. James: I believe that is so, that some fish will die after they have performed the act; the habits of different fishes are, of course, known to those who have been observing them carefully.

Mr. Clark: I would like to ask Mr. Hubbard, as he has had much experience on the Pacific coast, if in his judgment it is something in relation to the act of spawning that kills the Pacific salmon, or is it due to their hard work reaching the spawning grounds?

Mr. Hubbard: My opinion is that the salmon arrive at their spawning grounds in fairly good condition. Of course, the longer they are in fresh water the weaker they will get, but the majority arrive in fairly good condition. The act of spawning is very exhaustive, and they are worn out, and it seems to be the nature of them to die after performing the act.

Mr. Clark: Then you are not positive that it is the work, or lack of food, or act of performing their functions, or all three combined?

Mr. Hubbard: I think it is the nature of the fish to die after spawning.

Mr. Clark: In holding whitefish in crates and in handling them in our spawning work, they receive injuries so that I don't believe three out of a hundred would live long if put back into the river. We held some of our whitefish in crates nearly two months last fall, but, of course, they had no food during that time.

Mr. Ravenel: Except that they were held in the river.

Mr. Clark: That is true; but we examined them and found nothing in their stomachs, so they didn't eat; and those fish at the end of that time were apparently in just as good condition as when put in the crates.

Mr. Davis: In regard to whitefish eating, it seems as if they did just about as well without food as with. We have a couple of whitefish weighing about two pounds apiece; I think they were

kept in an aquarium last fall and all winter, and they are in the aquarium at Paris now, and apparently in as good condition as when taken out of the river.

Mr. Clark: I don't think whitefish eat anything at all after they commence running up the river. I have never been able to find anything in their stomachs. Mr. Nevin told me last evening that he had found whitefish eggs in the stomach of a whitefish. I never have and I have examined the stomachs of thousands.

Dr. James: I think starvation is largely the cause of many of the salmon dying. The salmon will go up in great schools, and at the mouth of the more rapidly flowing streams they will accumulate in such numbers that a man can almost walk over them dry-footed; they crowd together in such a way that they injure one another, and there certainly isn't enough food for the number of fish that go there and have to await their turn to get up. Then they have to go up streams where there is a great deal of exertion required, and they must have nutrition in order to get the force to mount those rapidly flowing streams. Then they have the spawning to do, and they have to go back again, and I think starvation enters largely into that.

Mr. Hubbard: In regard to the food supply for the salmon in the streams, I wish to say that the steelheads will go up the same streams as the salmon do, and the steelheads out there are a large fish, 20 or 25 pounds; they go up as the salmon do and return to the ocean. Sometimes at our stations we put the racks in early in the spring and we sometimes catch some of those steelheads by that means; those are all returning down the stream and collect on the upper side of the racks, and I have known them to stay there all summer and then go down to the ocean in the fall, but what quinnat salmon go down all die in a few days.

Mr. Thompson: I would like to ask whether these quinnat salmon that are on their way out will take the hook?

Mr. Hubbard: I have known of a good many being caught with a hook. I don't know whether with a fly, but you can't find anything in their stomach, and I think they just bite.

Mr. Clark: I have caught the Pacific salmon in the McCloud River, as large as 24 pounds, using a red flannel rag as bait.

The President: I have a friend who has caught the salmon in one of the rivers in the State of Washington with a fly. I can't say whether they were going up to spawn or not. I want to inquire—it was spoken of here as being the nature of the fish, as though it was the nature when they spawned to die—if that was so wouldn't they all be the same size or same age? Do the fresh water conditions enter into the question of its food supply? You hear of all sizes of salmon being caught. Theorizing upon it without any practical knowledge it would seem as though some other cause than nature entered into it.

Mr. Ravenel: Why is there any more reason that salmon should be of the same size at the same age than man? You can take any number of trout fry, six months old, fed exactly the same number of times, and find some twice as large as others.

Mr. Bryant: How small do you find them when they have spawned?

Mr. Hubbard: We often find very small males; the females are generally larger; I don't know of any females with spawn in them that would weigh under six to eight pounds.

Mr. Bryant: Do the males die as well?

Mr. Hubbard: Yes. Three years ago we marked 5,000 salmon by cutting off the adipose fin, and in a little less than three years some of them were caught returning to the spawning grounds; the next year a few more were caught, and this year I understand they caught a few more of these marked salmon, so they do not all return the same year.

Mr. Bryant: Then they never spawn but once?

Mr. Morse: I would like to ask for information if both sexes die after performing the functions?

Mr. Hubbard: Yes, sir.

Mr. Thompson: I would like to have Mr. Hubbard state something in regard to the number of marked fish that returned each year, and also about the time of returning each year.

Mr. Hubbard: I am very poor to remember figures and statements, but the first year that those marked salmon were caught the cannerymen were requested to keep a record of those taken, and some thirty odd were reporetd, with the date of capture and weight. Since then many more have been captured, but they have kept no accurate record. I think over 100 were reported the first year they were caught, a little less than three years after they were marked and the years following I don't know the number, but some were reported.

Mr. Bryant: Whereabouts, Mr. Ravenel, do they go to in the ocean? Do they work alnog the shore when they get to the ocean, after being up in the fresh water, and where do they inhabit the ocean?

Mr. Ravenel: I will have to refer you to better authority.

Mr. Bryant: They are not caught in the ocean.

Mr. Ravenel: They are caught not a great distance off, very much like our shad.

Mr. Davis: Is it true that the salmon die upon their first spawning, that they never spawn but once?

Mr. Ravenel: We have only to conclude that, we don't know it, but since we assert that all the salmon that enter the rivers never return, we have got to conclude also that they never spawn but once.

Mr. Davis: What weight are the salmon when they spawn?

Mr. Hubbard: The average weight is 20 to 30 pounds.

Mr. Bryant: How long does it take them to reach that age?

Mr. Hubbard: Well, as I say, in from 3 to 4 years their weight is from 20 to 30 pounds.

The President: Are there any further remarks on the salmon, or inquiries?

Mr. Thompson: I would like to state that according to the report of the State Commissioners, the fish that were weighed ran from 12 or 15 up to 49 pounds. We are almost compelled to conclude that those fish were all the same age.

ADDRESS OF MR. GRANT M. MORSE, STATE GAME AND FISH WARDEN, PORTLAND, MICH.

Mr. Morse, being invited by the President to tell the Society something about his work in Michigan, said:

"I am not prepared to talk for record, but will be very glad to give you something of an idea of the work we are doing in Michigan for the protection and perpetuation of our wild life.

"Along this line I was very favorably impressed with the remarks made in one of the papers, expressing the wish that all State Commissions would work in harmony with this Society. I have enjoyed very much this meeting, and have conceived the idea that if we do work together with the protective agencies in the different states, much better work may be done by the exchange of ideas, and to that end we hope to add a little at the meeting next year at Milwaukee.

"In Michigan we have a State Fish Commission, which has to do with the propagation and planting of fishes. The propagation of the commercial fishes—whitefish and lake trout—last year, the last two years in fact, has been turned over to the U. S. Fish Commission, and the attention of the State Fish Commission has been given entirely to the inland waters. The fishes of the Great Lakes furnish food for the people of all the States, and I think it perfectly proper that the U. S. Commission should care for the work of propagating.

"The work of protection we deem in Michigan to be very important in connection with our propagating and planting, in that we are able to protect the young fishes to an age when they may be properly taken, and we deem this feature in our Great Lakes one of the most important, or really it is the main feature, that will lead to the perpetuation of the food fishes in those waters. We have fixed in our State upon a weight limit—two pounds for

whitefish and one and one-half pounds for lake trout—at which age they are supposed to reproduce themselves naturally.

"Our legislature in Michigan is much like the legislatures of other States, very careful of their appropriations, and especially for this work of protection. It requires the sentiment of the community to enforce protective laws, as it does any other law, and to get an appropriation for this work it requires a good deal of work to get them to understand the importance of such legislation. We are laboring at a good deal of disadvantage with our very small appropriation, the legislature only giving us $2,000 for the work of protecting the Great Lakes and inland waters. We have a lake coast of nearly 2,500 miles, and very much of it is good fishing ground, and commercial fishermen are found at nearly every village along the coast. We have this whole space to look after, together with the sentimental fishes in the inland lakes, where we are bothered with dynamiters, netters and other violators, besides protecting our game in the field and forest.

"In addition to this $2,000 we get a little revenue from our hunting license law. We have a law in our State that requires the payment by a non-resident of $25 license for the hunting of deer, and a resident license of 75 cents. We have from this a revenue of $4,000 or $5,000; that makes $6,000 or $7,000 annually to expend. This is all the fund we have for State deputies, of which we are allowed ten, who are paid a per diem and expenses, and who work under the direction of the State Warden. In addition to this we have County Wardens, who are paid by the Boards of Supervisors, and most of you know how well County Supervisors pay wardens or others whom they are employing. But we get out of these county deputies a certain amount of work which materially aids our State men. A very few of the counties give us no aid, being against the sentiment of the work, and these vote an appropriation of only one dollar per year for county wardens. In the last five years we find that sentiment is rapidly growing for the better protection of our game and fish. In some counties, for instance, a year ago where we were unable,

with the best of evidence, to get a conviction by a jury, this year in those same counties we have not missed a conviction. Now you will see how rapidly sentiment changes in this work. In one of our counties where we have a great deal of commercial fishing, last year we had one party arrested three times for taking small fish—whitefish or lake trout—and he got clear every time. This year the first time he was arrested he was convicted and punished, and the second time convicted and punished and each time by a jury of his peers, so that we feel we have changed the sentiment in bringing before the people the necessity for this protective work for the perpetuation of our commercial fisheries.

"In taking the small fish, of course, before the age at which they reproduce, the commercial fishermen practically 'kill the goose that lays the golden egg,' while to leave them means replenished and prosperous fisheries; they cannot expect 'to reap if they do not sow.'

"This is true also of the game department. By careful protection we find our quail are increasing very rapidly from year to year. We have now a 40-days' shooting season, from the 20th of October to the 30th of November. This includes quail, partridge, wood-cock and snipe. I think we never had as many quail in the field as we had last season. They are rapidly going northward as agricultural operations have increased in that direction, and we find our quail now in plenty in Emmett County on the west shore and Cheboygan County on the east shore, but we don't get any quail in the Upper Peninsula as yet. However, deer and partridge are very plentiful in that portion of our State, holding their own in good shape.

"The work of protection, in connection with the work of fish commissions, it seems to me, should be supported, and that these two departments should always work in harmony. It was spoken of yesterday by one of the members, I think Mr. Bryant, of the Wisconsin Commission, that they were able by keeping out of protection, saying nothing about that, to get a good appropriation for propagating; I think that is right. I think the work of

propagating and distribution is a large work in itself, and if it is properly taken care of by these commissions they should look after it entirely. The work of protection is an entirely different work and produces a good deal of animosity, and perhaps this may have influenced their legislature in separating the two departments; still, having them work hand in hand with protection, for the common good, I believe is the proper way to perpetuate our fisheries and our game reservations." (Applause.)

DISCUSSION ON THE CARE AND FEEDING OF BROOK TROUT, SUGGESTED BY THE TRIP TO THE EAST FREETOWN TROUT HATCHERY.

The President: Yesterday you had a good opportunity to see one of the practical commercial hatcheries, and it seems to me that we fish-culturists can get more practical points from a man who is in the business to make what he can out of it than from any other source. We are fortunate in having identified with us this year more of the commercial fish-culturists than ever before. You did not have an opportunity yesterday to question Mr. Hurlbut very much, and it occurred to me that there might be some questions which you would like to ask him. I want to ask two or three questions for information. I want to ask first whether any of the fish-culturists have considered the vegetation which grows in the bottom of our ponds—I don't know the name of it, but it is very common; in many ponds it grows during the summer and then rises to the top in hot weather. Whether it is objectionable? Whether there is any preventative for it?

Mr. Root: Do you mean that green growth?

The President: That green growth. You can watch it in the summer and see it rise up, making a tunnel shaped appearance like a water-spout, and gradually cut itself off from the bottom and float on top.

Mr. Root: I had occasion, Mr. President, to inquire of one of our scientific men in Providence in regard to that very matter; he said that the vegetation would not grow in a depth of water over fourteen feet; it is only in shallow ponds that it will grow. There is no remedy for it.

The President: Well, there seems to be no one here that can give us a remedy.

Mr. Root: There is no remedy. In black bass ponds where that green matter is, black bass will not bite. On Block Island they have a great many ponds and the deepest pond they have is filled with this green scum, and you cannot catch black bass while that is there, but it doesn't last very long.

Mr. Lane: I will give you my experience, but perhaps all others have had the same. I believe in a certain measure that this growth is a good thing for trout, I think that it is a benefit, but over and above a certain amount of it I think it is an injury, and all the way I get clear of it is to keep the water as deep as I can and covered up from the sun. I believe at the same time that the fish eat a certain amount of it. I have examined and experimented with fish in ponds containing it, and they will hardly ever take but a very little artificial food and yet they will thrive perhaps better than those that are a great deal thicker and fed artificially. I believe it is a good thing, a certain amount of it.

And now while I am up I have one little point on the food of fish, and if I am wrong I wish to be corrected; if I am right I shall be glad to have given my experience. If you feed liver, I should prefer to have it the same day as killed and not after it is tainted; what I shouldn't want to eat myself I wouldn't feed to young fish. I believe food of that kind is injurious, does more harm than if it is not fed at all. After trout get to be a larger size I think that liver-fed trout is a stumbling block to many, they say they don't want to eat them; whether they have that taste or not I don't know, but most everyone says they do, and for that reason I have experimented with a food mixture that I make in this way: I take a common farmer's boiler and put in three buckets of water, then put in a pound to a pound and a half of salt, which is dissolved in the water. Then, when the water comes to a smart boiling point, I put in what is called animal meal—that is powdered and ground up fine—then add fine feed and common Indian meal, mixed—I mean shorts, only it is a different grade, a finer grade than shorts. I then cook and mix it to a state where it will be hard when cold, then force it

through a five-inch pipe with a cap on the bottom filled with holes—put the mixture into that and force the food right through the holes and make it into little worms about as large as a pipe stem. This separates it so in a few minutes it dries up enough so that when you throw it into a pool it does not crumble off, but the worms break apart and the fish will eat this about as quick as they will meat, and by putting it into that shape they don't pollute the pool with a mess of dirt. Whether the salt is a benefit to it, or whether the animal meal gives it a fine taste that the fish like, I don't know, but they thrive on that better than on liver alone. I don't know now if anybody has any better way to feed trout; if they have I should like to hear it. I came here to learn and I think I have learned, but if I can learn any more I would like to.

Mr. Ravenel: How young are the trout that you commence to feed on that?

Mr. Lane: Well, I feed the fish hatched this spring along this fall, the young fingerlings.

Mr. Ravenel: In other words, you don't use it much until they are nearly yearlings?

Mr. Lane: No, sir.

Mr. Ravenel: You know the use of mush and liver are almost universal in government stations; it is very fully described in quite a number of our publications. They start using that within two or three months after the fry commence to feed. We have never used the ground animal meal that you speak of.

Mr. Lane: Its being ground I find it digests very easily. At most of these stations don't they feed liver in large quantities?

Mr. Ravenel: They have produced some very remarkable results through feeding in that way, the fish having attained a length of eight inches within a year from the time the eggs were taken; that was an exception, of course, as the majority were not as large, but I am speaking of the exceptions.

The President: Mr. Lane, I will inquire if you don't think your meat ground up and cooked and mixed with your mush would be as well as animal meal?

Mr. Lane: I don't know but it would; I think its being ground so very fine will produce a more rapid growth than it would to take the liver raw.

Mr. Thompson: Regarding the food, I would like to state that it is to be considered according to the point of view in which you look at it. The commercial hatcheries take a very different point of view from the Commissions; they wish to grow a fish that has a very delicate flavor, and on that account they necessarily must get some food that will produce it, and of course we know that with fish as with anything else, there is a change of flavor according to the kind of food consumed. One variety of food alone I think is not the best, a change is beneficial. But in our work we are not interested in the flavor at all, we are not producing fish to turn on the market, but to plant in public waters where the natural food does the rest, and gives them that peculiar flavor that has created such an appetite for trout. So, on that account, we have no interest in getting a food with a flavor, and I think in that way our standpoint is a little different.

Then in regard to this green slime that is found in ponds, I wish to say that the Iowa station had some experience with it. In one pond, I remember, there was a sandy and gravel bottom, no loam and scarcely any vegetation, on this sandy bottom the vegetation did not take hold rapidly. Other ponds there have a loam and mud bottom where there is more or less vegetation which took hold and spread rapidly—and this slime also reproduced itself very rapidly. The fish that were placed in the pond first mentioned and spawned on the sandy bottom did not do very well. The bottom attracted the sun, there was scarcely any protection, and, as the spawning operations were visible, they were interrupted in them by other fish coming around and eating the spawn after it was extruded; the few fish hatched there found no food, and there were comparatively no results from that pond; but the other ponds that I speak of, where the bottom was covered with this vegetable growth and slime, produced good results—the fish there did well. They would select their spawning place

where it was protected from the sun and from the observation of the other fish; they were more successful in the act of spawning, and the eggs were not bothered, nor the young fry disturbed to the same extent, and when they began to eat they found apparently an abundant food supply on the vegetable growth and also on this green slime, and they did quite well. The green slime and the vegetable growth also furnish a hiding-place for the young, so that the older ones cannot pursue and attack them.

There was one statement Mr. Lane made I didn't understand. He spoke of the fish eating this slime. I would like to ask whether they eat the slime, or merely the animal growth that lives on that slime?

Mr. Lane: It may be the animal growth, but the slime disappeared.

LACK OF FERTILIZATION VS. ARRESTED SEGMENTATION.

BY J. J. STRANAHAN, BULLOCHVILLE, GA.

A series of experiments was carried on by the writer during the whitefish spawning season, with the view of discovering, if possible, what causes monster embryos in fish eggs, especially those partaking of the twin character or having more than the normal number of parts or organs.

Probably a majority of biologists hold that these monsters are occasioned by injury to the egg at certain critical periods during development. In fact, it is conceded that these monsters can be so produced artificially in the case of the chick, and doubtless others, but it is also held by some eminent embryologists that they may likely also be produced by more than one spermatozoon entering the egg through the micropyle at a time when sufficient water has entered the egg through its membranes to lift them from the disc.

The first series was carried on with a view of producing monsters by injury. For this purpose a four-ounce glass jar was used. Into this one-half ounce of eggs from a given lot were placed, when the jar was half filled with water and securely corked. It was then dropped ten times into a wooden pail half filled with water, from a height of four feet, the jar striking the bottom of the pail with considerable violence.

Lots of eggs were thus treated, beginning with the first one-half hour after the eggs were taken and impregnated, the second one hour later and then an hour up to and including the ninth lot

On examining these eggs under the microscope after they had been 48 hours in running water, only one twin disc was found, and that not very well defined, 100 eggs of each lot having been examined, showing that the injuries had not caused them in any considerable numbers.

The experiment, however, resulted in what was to the writer a most startling discovery. Five lots of one hundred each, taken from the same lot from which the eggs had been procured for these experiments, showed but 3 2-5 per cent unimpregnated eggs and but few with ruptured yolks, while those subjected to the injury process showed large numbers of what appeared to be unimpregnated, or which looked like those which fish culturists have regarded, when viewed under the microscope, as unimpregnated, the disc being hemispherical, semi-transparent, amber-colored and devoid of all appearance of segmentation. One thing is sure, all of these eggs were dead.

The following table shows the number of eggs appearing normal, that is, where segmentation had taken place, those with ruptured yolks, and those having the appearance of being unimpregnated:

	½ Hr.	1½ Hrs.	2½ Hrs.	3½ Hrs.	4½ Hrs.	5½ Hrs.	6½ Hrs.	7½ Hrs.	8½ Hrs.
Eggs, Normal.....	36	53	61	64	66	65	66	89	88
Eggs, Ruptured yolk .	57	36	27	15	12	9	8	3	3
Eggs, Unimpregnated.	7	11	12	21	22	26	26	8	9
Total	100	100	100	100	100	100	100	100	100
Twin Discs	0	0	0	0	0	0	1	0	0

It should be here stated that one twin disc was found among the five hundred eggs which had not been submitted to the injuring process.

In another experiment, eight lots of eggs were given ten shakes each with as uniform force as possible with the right arm. The results were substantially the same as in the case of the above, with the exception that there were rather more ruptured eggs than in the former case.

There is obviously but one conclusion to be drawn from the result of these experiments, and that is that the larger portion

of these eggs which seem, as viewed under the microscope, to be unimpregnated, are really fertilized, but segmentation has been arrested as a result of the injuries received; in other words, they have been killed.

If we concede this theory to be true, it then follows that many of the eggs which we have generally supposed to be unimpregnated are really those where segmentation has been stopped through injury to the disc, and since in the case of the pike perch egg this loss of ten runs up to one-fourth or even one-third of the whole, it would seem that the remedy should be sought in greater care in handling the eggs up to the point where they are fully cushioned by the absorption of water. This view was fully sustained at the Put-in-Bay station of the U. S. Fish Commission during the spawning season of 1899 in the case of several lots of pike perch eggs taken by the station force from the boats of the fishermen near by, brought to the station in the milt and manipulated with great care on the floor of the hatching room. These lots, embracing some twenty jars of eggs, hatched out from 80 to 90 per cent of fry, and were by odds the best in the house.

THE BREEDING HABITS AND GROWTH OF THE CLAM.*

BY PROFESSOR A. D. MEAD, PROVIDENCE, R. I.

In view of the deplorable decrease in the production of soft-shelled clams on the shores of Narragansett Bay, the Rhode Island Commission of Inland Fisheries two years ago requested Dr. J. L. Kellogg and myself to study the life history and habits of this most valuable shell-fish, to ascertain, if possible, the true reasons for its gradual disappearance, and to suggest a practical means either for repleting the natural clam grounds or for establishing artificial clam culture. Since then the investigations have been extended by the U. S. Fish Commission to other shores than those of Rhode Island, but to these I shall not refer in this paper. Without going into details or describing particular experiments, the general conclusions drawn from the work in Narragansett Bay may be summarized as follows:

1. The preliminary survey indicates that there are more than fifty miles of Rhode Island shore in the Bay alone which are more or less available for the rearing of clams.

2. The range and adaptability of the clams are great. They will thrive in various kinds of soil; in sand, mud, clay, and among stones; from near high-water to considerably below low water; from brackish ponds to the densely salt water of the outside shore and Seaconnet river.

3. It is the general testimony that the clams have been decreasing in quantity gradually during the last twenty years, and it is an undisputed fact that they are now comparatively scarce. The disappearance has been nearly uniform in all parts of the Rhode Island shore of the Bay; in localities protected from the wash of the steamers and not contaminated by the waste of towns, as well as in localities less fortunately situated. It is still, in certain localities, comparatively abundant below the low-tide

*Received after meeting adjourned.

mark, where it cannot be taken by the ordinary method of digging, but only by the more elaborate and unusual method of churning. In Cole's river, where, under Massachusetts laws the clams are better protected, they are much more abundant than in the neighboring Rhode Island estuary, Kickemuit River, though both are similarly situated and the latter has been proved by its past history to be a locality as favorable as the other. These facts and others indicate clearly that the decrease in the clams of the State is due mainly to the unlimited and promiscuous digging and not to changed natural conditions.

4. That frequent digging up of the ground is necessary, or that it is even a positive benefit to the clams, by rendering the ground soft, is probably a fallacy. The fact that often the finest specimens are found in hard, stony ground, or in hard clay flats, which are only occasionally exposed to the clam-digger at an unusually low tide, and the observations made during the summer upon the growth of unmolested specimens, indicate that they grow well, at any rate, if left undisturbed. The habits of the animal, in obtaining food, point to the same conclusion. The food is obtained from the water which is taken in through the siphon, and not from the soil in which the clam lies. So long as it is well located, therefore, and in communication with the water it is distinctly not to its advantage to be disturbed, particularly at the risk of being buried deep under the mud or left on the surface, a prey to crabs, mummichogs, star-fish, and other enemies. Clams less than one-half an inch long will burrow very rapidly when they are exposed on the surface of the mud (if covered by water), but those upwards of three-fourths of an inch will often lie for a long time without even trying to burrow, and then are not very efficient in getting into the mud. This method of "cultivation," although undoubtedly excellent for apple trees, is not, however, equally good for clams.

5. The breeding-season of the clam is at its height in June. The exact limits of the period have not been ascertained. The eggs are extruded in great numbers into the sea-water where they are fertilized and in a short time develop into very minute

free-swimming forms with little resemblance to the adults. In this condition they live an active life and are carried hither and thither by the tides for several days at least before they settle down to the bottom or attach themselves to some object like a stone or piece of sea-weed. The obvious result of this method of reproduction is that the young clams do not remain where the eggs are laid but are very widely distributed by the tides. This fact readily explains the sudden appearance of a large set of clams in a locality where the adults are scarce. It is not at all unlikely, moreover, that the clams below tide-mark, and out of reach of their human enemy, produce a large proportion of the clams which set on the shore.

6. In the manner of setting, and in the peculiar characteristics of the young clams after they have set, there are two facts which will prove of the greatest service in clam culture. (1). The clam set is not evenly distributed even in regions of the Bay where the water is full of the free-swimming young, but in some localities the set is extremely thick while in neighboring localities, a few rods distant, only a small number may be found. (2). The young clams, from one-fourth to one-half an inch long, have a remarkable capacity for burrowing, a capacity which is greatly diminished as the animal grows larger. At the proper season, therefore, and in the localities where the set is thick, the clams can easily be collected in immense numbers by means of a sieve; and fortunately the time when they can be collected with the least difficulty happens to be the very best time for transplanting. By far the best time for collecting and transplanting is from the first week in July to the first or second week in August. It is hundreds of times easier to collect them at this season by means of a sieve than at other times of the year with a clam-hoe. There is perhaps even a greater advantage in transplanting at this time, from the fact that the clams can now be sowed broadcast like grain and will soon burrow into the sand; whereas, larger specimens from one inch upwards must necessarily be planted and carefully covered or a great loss will result. An additional fact in favor of transplanting at this time is that

in some localities there are very great quantities of young clams set early in July which, if not taken up and transplanted, are destroyed by shifting sand or from some other cause. In other localities the clams are set too thick to grow to the best advantage, and they would actually be benefited by being thinned out.

7. It seems almost certain that the explanation of the abundant set in a limited area, and the meagre set in the neighboring localities, is to be sought in the position of the shore with reference to the tides. When this explanation has been worked out in detail it may be possible artificially to construct and place apparatus to collect the set in equally large quantities.

8. The experiments of transplanting have demonstrated that under favorable conditions the rate of growth is more rapid than is usually supposed, some of the June set having reached a length of nearly two inches by the middle of September. The experiments demonstrate also, the fact that there are great differences in the rate of growth according to the food supply which is obtained from the water, and that the most rapid growth may be expected of clams which are under water most of the time.

9. The size and age at which the clam reaches sexual maturity is obviously a problem of considerable importance. It is the general opinion, and has been sometimes stated in print, that they do not spawn until the third year. That this opinion is erroneous there can be no doubt. The clams of last year set at Wickford station were ripe this year and the eggs from these specimens were artificially fertilized.

The observations from the same station indicate clearly that (1) the clams would again be abundant upon our shores could they receive, for only a few years rest from the unreasonable and promiscuous digging. (2) From the biological point of view clam culture is as practicable and feasible as oyster culture. The legislative question—the control of shore by private individuals is, to be sure, another story.

RESPONDING TO "THE PRESS."*

BY FRED J. ADAMS GRAND RAPIDS MICH.

Gentlemen of the American Fisheries Association—When I was asked by your secretary, Seymour Bower, to prepare something for your annual meeting, I threw up my hands. I do pretend to know something about brook trout and rainbow trout, but for me to pretend to tell or write anything interesting for members of your Association, seemed beyond my ability. I could write fish stories until the cows come home, and I could describe the delights of Michigan streams until you all grew weary of listening, but I don't know that I could give you a single new thought or idea upon the great subject with which you are all so well familiar. Mr. Bower spoke of the benefits of artificial propagation and planting in public waters, but it would be a dry subject. It is a conceded subject to begin with. Everybody who knows anything at all about fish or fisheries knows that no question mark can be put after any of our hatcheries or their work, and the man who would attempt to deliver himself upon the benefits of artificial propagation or subsequent planting, would be like a man who attempted to descant upon the benefits of the joyous hereafter.

There is one feature of the subject, however, which we can all of us consider. It refers to The Press. This sentiment has been responded to so often and so completely in all the varied forms that ingenuity can devise, that it is with some little fear and trepidation that I attempt to give you anything new upon the subject. And yet, there is a very decidedly new feature so far as fish and fishermen are concerned.

The newspaper of to-day is admitted to be the great educator of the masses. It creates sentiment favorable and unfavorable. It educates the people upon all topics of interest upon which the writers themselves are posted. And yet how few of

*Received after meeting adjourned.

our newspapers to-day ever publish anything reliable or readable upon the subject of inland fishing. I know nothing about the deep sea fishing or the sport to be found along the coast, but I do know and realize full well that few of the writers for our newspapers of to-day have any real conception of the delights and the experiences of inland fishing, especially of brook trout. We read descriptions which no doubt please the greaat masses of the people very well, and we read stories which to the tenderfeet sound well enough. We read in magazines of great catches being made under conditions quite as harrowing or as romantic to the ordinary reader as they are amusing to the old timer, and they are published in all good faith, too. It was but a few weeks ago that one of the metropolitan papers referred to a man "sitting upon a log in the middle of the stream fishing for trout," and another very excellent newspaper recently contained a Sunday story about two trout fishermen who "waded upstream until they were all worn out, in the search for speckled beauties." Similar reference might also be made to many of the illustrations, intended to show scenes and incident upon trout streams. They picture whiskered gentlemen with the inevitable English outing cap, a briar pipe, double-breasted jackets and top boots, and the fisherman is usually using a long and well bent rod from the bank or standing in very shallow water. Of course, many fishermen smoke briar pipes, and many of them fish from the bank, but every trout fisherman knows that the picture is by no means true to nature.

The trouble is that there are so few of the newspaper men who know anything about the sport. In our busy life we have little time for such things. When an editor or reporter gets a little time for rest and relaxation he goes to put it in along lines familiar to him, and few of us have apparently had the opportunity to become acquainted with the delights and the very substantial benefits of a day or a week upon the trout stream. The members of your Association can do some missionary work in this field with promise of certain and satisfactory results. I know this from my own experience.

Michigan is one of the best states for trout fishing in the country. We who are fortunate enough to live here, are just a little conceited of our resources in this respect. Years ago we had grayling in abundance but in the absence of successful artificial propagation they have disappeared so rapidly as to become practically extinct in Michigan waters. Under the magnificent work of the State Fish Commission, the number of trout streams have multiplied until almost every little brook is a trout stream. The number of fishermen has increased in the same proportion, too. A few years ago the trout fishermen who were really enthusiasts, were few in number, while the fly fishermen of the state could almost be counted upon the fingers. To-day there are thousands in the state and practically all of them use the fly. In Grand Rapids there is a fishing club of over four hundred members, each of whom uses the fly practically altogether, and the membership of this club is but a small percentage of the total number of good fishermen.

But to return to the subject! Of all my own acquaintance among the newspaper workers of Michigan I do not know of one who takes any personal interest in trout fishing. There are bass fishermen, yachtsmen, oarsmen and experts in other lines, but I cannot recall having met an active newspaper man from this or any other state, either upon the stream or upon the conversational fishing stream. I probably would have remained in the dark myself had it not been for one of your members, "Uncle" Horace W. Davis, president of our State Fish Commission. It was seven years ago when he induced me to go upon a little one-day trip to a stream forty miles north of the city. A borrowed outfit was easily obtained and upon the return I could not get to the store quickly enough to buy one of my own. I was green at the game but I learned. I caught but few fish but Davis landed enough for both and I came home with an enthusiasm which has never diminished. Piece by piece the outfit has been purchased until now it is as complete as my needs seem to require, and I am no longer a borrower of rods or waders, but am in a position

to lend and to divide up with the less experienced or less fortunate on the return trip.

You gentlemen can do for others what Davis did for me. You can get newspaper workers interested in the great sport which we all so thoroughly enjoy. Speaking from an experience of fifteen years I can promise you that you will find them as royal a lot of men as ever cast a fly and with the true sportsmanlike feeling awaiting only cultivation and development. They will not be looking for the best end of it either. In olden days it was a tradition that newspaper men were continually looking for something free. It is not so to-day. They would thoroughly enjoy plenty of God's own free sunlight and fresh air, and the freedom from care and restraint so characteristic of the stream, and they would enjoy meeting the free heartedness and the freemasonry always known among fishermen, and the tenderfeet will need plenty of free advice and instruction, but beyond that you will have no cause for worry.

I think you will see the point I wish to make. The newspapers are the educators; then why not all turn in and educate the newspapers. We are all interested in trout fishing and in the preservation of our streams. In order that the streams are restocked, artificial propagation is necessary, and this costs money. Legislatures must vote the money and in order to do this they must have the people behind them. In order to get the people, we must have the newspapers, and there is no better way under the sun than to make the men who make the newspapers thoroughly acquainted by actual contact with the situation.

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Rosenberg, Albert, Kalamazoo, Mich.
Ruge, John G., Apalachicola, Fla.
Russel, Henry, Detroit, Mich.

Schweikart, Walter, Detroit, Mich.
Seagle, Geo. A., Wytheville, Va.
Self, E. M., Bullochville, Ga.
Sellers, M. G., Philadelphia, Pa.
Sexton, Cramer, Murfreesboro, Tenn.
Sherwin, H. A., 100 Canal st., Cleveland, O.
Smith, L. H., Algona, Iowa.
Smith, Dr. Hugh M., U. S. Fish Commission, Washington, D. C.
Smith, Capt. J. A., Woods Hole, Mass.
Solmans, Alden, South Norwalk, Conn.
Southwick, J. M. K., Newport, R. I.
Spensley, Calvert, Mineral Point, Wis.
Starbuck, Alexander, Cincinnati, O.
Starr, W. J., Eau Claire, Wis.
Stelle, G. F., Chicago, Ill.
Sterling, J. E., Crisfield, Md.
Stewart, Chas. E., Westerly, R. I.
Stewart, A. T., Northville, Mich.
Stone, Livingston, Cape Vincent, N. Y.
Stranahan, J. J., Bullochville, Ga.
Stranahan, F. A., Cleveland, O.
Stranahan, F. F., Cleveland, O.
Stranahan, H. B., Cleveland, O.
Sykes, Arthur, Madison, Wis.
Sykes, Henry, Bayfield, Wis.

Tawes, J. C., Crisfield, Md.
Taylor, A. R., 318 Main st., Memphis, Tenn.
Thayer, W. W., 234 Joseph Campau ave., Detroit, Mich.
Thompson, Carl G., 78 Henry st., Huntington, Ind.
Thompson, W. T., Nashua, N. H.
Thompson, W. P., 1020 Arch st., Philadelphia, Pa.
Tinker, E. F., St. Johnsbury, Vt.
Titcomb, John W., St. Johnsbury, Vt.
Trumpour, D. A., Bay City, Mich.
Tubbs, Frank A., Neosho, Mo.

Tucker, Edmund St. George, Bedford Row, Halifax, N. S.
Tulian, Eugene A., Leadville, Colo.

Van Cleef, J. S., Poughkeepsie, N. Y.
Vincent, W. S., Leadville, Colo.
Vogelsang, Alexander T., Mills Building, San Francisco, Cal.

Walker, Bryant, Detroit, Mich.
Wallett, W. H., Put-in-Bay, O.
Walters, C. H., Cold Spring Harbor, N. Y.
Walton, C. H., 1713 Spring Garden st., Philadelphia, Pa.
Ward, Prof. H. B., Lincoln, Neb.
Webb, W. Seward, Forty-fourth st. and Vanderbilt ave., New York.
Wentworth, Nathaniel, Hudson Centre, N. H.
Weed, W. R., Potsdam, N. Y.
Wetherbee, W. C., Port Henry, N. Y.
White, R. Tyson, 320 Bridge st., Brooklyn, N. Y.
Wilbur, H. O., 235 Third st., Philadelphia, Pa.
Wilbur, P. H., Little Compton, R. I.
Willard, Chas. W., Westerly, R. I.
Willetts, J. C., 40 Wall st., New York.
Williams, J. A., St. Johnsbury, Vt.
Wilson, S. H., Cleveland, O.
Winn, Dennis, Nashua, N. H.
Wires, S. P., Lester Park, Duluth, Minn
Wood, C. C., Plymouth, Mass.

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

HONORARY.

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

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

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

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

Southside Sportsmen's Club, Oakdale, L. I., N. Y.
Sweeny, Dr. R. O., Lester Park, Duluth, Minn.

The President of the United States.
The Governors of the Several States.

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

CORRESPONDING.

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

Armistead, J. J., Dumfries, Scotland.

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

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

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

Feddersen, Arthur, Copenhagen, Denmark.

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

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

Jaffa, 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.

Maitland, Sir James Ramsay Gibson, Bart., Howieton, Stirling, Scotland.

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

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

Olsen, O. T., Grimsby, England.

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

Senior, William, London, England.

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

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

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

Trybom, Dr. Filip, Stockholm, Sweden.

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

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

Young, Archibald, Esq., Inspector of Salmon Fisheries, Edinburgh, Scotland.

RECAPITULATION.

Active	244
Honorary	53
Corresponding	26
Total membership	323

CONSTITUTION.

(As amended to date.)

ARTICLE I.

NAME AND OBJECTS.

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

ARTICLE II.

MEMBERS.

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

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

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice-President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which, with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

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

ARTICLE V.

CHANGING THE CONSTITUTION.

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

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirtieth Annual Meeting

JULY 19 AND 20, 1901.

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

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

Officers for 1901-1902.

President, - - -	General E. E. Bryant, Madison, Wis.
Vice-President, - -	Eugene G. Blackford, New York City.
Recording Secretary, -	George F. Peabody, Appleton, Wis.
Corresponding Secretary,	John E. Gunckel, Toledo, Ohio.
Treasurer, - - -	C. W. Willard, Westerly, R. I.

EXECUTIVE COMMITTEE.

John W. Titcomb, *Chairman*, St. Johnsbury, Vt.

George T. Mathewson, Thompsonville, Conn.

I. H. Dunlap, Washington, D. C.

Henry O'Malley, Baker, Wash.

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

J. J. Stranahan, Bullochville, Ga.

NOTE.

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

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PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Friday, July 19, 1901.

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

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

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

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

Honorary membership.

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

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

We are assembled for educational purposes with as much in the line of social intercourse and good fellowship as we can crowd in on the side. I am afraid however that we will not have an opportunity to crowd in very much "on the side," inasmuch as our gathering a year ago must have been composed largely of Seventh Day Adventists, as they set this meeting so that if we consume the three days we would have to work on Sunday, the

same as they do. The consequences are that this year we will have to crowd three days' work into two or desecrate the Sabbath; so we must get right down to business and hurry along.

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

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

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

On my way over, the thought occurred to me that, although we are now few in numbers, this organization is destined to grow

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

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

(Applause).

We will vary our program as we have really less than two days in which to do the work of three, and will therefore have to rush matters with all possible speed. With the permission of those present I will forego the appointment of committees until this afternoon, as I understand there are more members to arrive about noon. Just exactly what the program is as regards the desires of the Wisconsin Fish Commission, I am not fully in-

formed; the only thing I know of is their generous invitation, without expense, to take this body of gentlemen to the Bayfield Hatchery; I understand they have furnished a private car to be attached to the regular train. Every one who can should avail himself of this invitation and visit the Bayfield Hatchery, which is a most excellent one in every respect.

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

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

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

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

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

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

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

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

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

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

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

Motion seconded and unanimously carried.

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

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

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

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

AFTERNOON SESSION, JULY 19.

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

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

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

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

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

Report adopted and members elected.

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

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

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

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

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

Report of treasurer referred to auditing committee.

The President: The committees will report tomorrow morning.

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

Mr. Clark then read the following:

REPORT OF BAIRD MEMORIAL COMMITTEE.

Woods Hole, Mass., July 13, 1901.

To the President,
American Fisheries Society,
Milwaukee, Wis.

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

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

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

At a called meeting of the committee held at Washington on February 3, it was decided, after considering the probable amount of the subscriptions, that the proposed memorial take the form of a natural boulder with suitably inscribed artistic

bronze tablet; and full powers for determining the details and proceeding with the erection of the monument were delegated to a sub-committee consisting of the chairman and treasurer.

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

Respectfully submitted,

H. M. SMITH.

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

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

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

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

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

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

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

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

(Great laughter and applause).

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

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

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

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

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

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

When I read that the Fish Commissioners of a state plant millions upon millions of fish in its waters, I feel as though they are responsible for the millions and millions of lies that will

be told by the fishermen after the fish get big enough to be caught. But a good commissioner does not care how much anybody else lies as long as he is truly good and can tell the truth himself.

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

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

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

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

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

The paper was then read by the secretary.

General Bryant here took the chair.

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

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

(Invitation accepted).

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

Motion carried.

EVENING SESSION, BANQUET ROOM, 8 O'CLOCK.

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

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

Saturday, July 20, 1901.

MORNING SESSION, 10 O'CLOCK.

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

The committee on location and time presented the following report:

REPORT OF COMMITTEE ON LOCATION AND TIME.

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

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

Report received, accepted and unanimously adopted.

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

REPORT OF COMMITTEE ON NOMINATIONS.

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

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

Vice President, Eugene G. Blackford, New York.

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

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

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

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

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

Report unanimously accepted, adopted and nominees declared duly elected.

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

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

The subject of fish culture with me is of necessity more a by-study than a pursuit to which I can give my undivided devotion, but I am very much like old Ethan Allen, of Green Mountain memory, who said that of "all the Lord's cattle on the thousand hills he best preferred soldiers for companions." I can paraphrase that honestly and say that of all the Lord's cattle on a thousand hills I best enjoy the society of men engaged in fisheries and fish culture, and can co-work with them in my feeble way with hearty satisfaction. It is the tendency of human nature, we know, for every man to exalt his own vocation. That

idea comes down to us from the classics in the old adage, "There is nothing like leather." The story is told that when an ancient city was threatened with attack from the enemy, they called a counsel of all the people of the city to consider how they would best fortify it. The stone masons said with a sneer that of course they must use stone; the brickmakers said that by laying brick walls thick enough they would better stand the battering ram than stone; the lumberman insisted that a strong system of stockades would be built the quickest and would best withstand attack. They called up the old tanner and he said, "Gentlemen, there is nothing like leather; you just peg down sole leather walls around this city and all the battering rams on earth cannot batter them down." Every man exalts his own vocation, but we who are engaged in fish culture are in no danger of overdoing. The work that we are doing is so beneficial to mankind, its possibilities so great, its power of usefulness to mankind so unlimited, that we may well exercise this failing of human nature and give to our pursuit due honor. It has been said that the man who makes two blades of grass to grow where one had grown before, is a benefactor of mankind. If that be so how much more is it so where one makes an hundred food-fish to grow where nature makes only one to grow.

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

Mr. Titcomb: That is right.

General Bryant: Let us go on then with this work, let us maintain this society. This society may not present such a showing in numbers at its conventions as the Elks, the Modern Woodmen, or other fraternal societies, but I can liken it best to

those old bottles of wine that have grown few and scarce in a cellar, of some ancient vintage, rich, mellow, delicious and nourishing—but the bottles are few. We have a small membership in attendance, but a large membership in sympathy, a large circle of readers who read with interest the papers that are submitted here. Let us keep up this work. Let us make the report of this society year by year, better and better. Let us dig deeper into all the problems that perplex us. I hope a hundred years from now the American Society of Fisheries will be presenting its annual report and turn back reverently and gratefully to the sterling spirits who worked for it in its youth and its earlier manhood. So far as I can help in my feeble way I promise you my best endeavors. (Applause).

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

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

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

REPORT OF THE TREASURER.

To the American Fisheries Society.

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

RECEIPTS.

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

DISBURSEMENTS.

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

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

CHAS. W. WILLARD,
Treasurer.

July 15, 1901.

REPORT OF AUDITING COMMITTEE.

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

Report of treasurer accepted.

Report of auditing committe accepted and adopted.

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

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

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

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

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

Dr. Mead's paper was then read.

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

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

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

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

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

Dr. Bartlett then addressed the convention.

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

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

AFTERNOON SESSION, 2:30 O'CLOCK.

Meeting called to order by the president.

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

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

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

Mr. Cohen's letter read.

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

REPORT OF COMMITTEE ON RESOLUTIONS.

Resolved: That the thanks of the society are heartily extended to the Chicago & Northwestern Railway Company and

the Wisconsin Central Railway Company, for courtesies extended in enabling the members of the society to visit Bayfield:

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

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

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

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

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

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

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

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

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

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

Motion unanimously carried.

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

The President: That will be done as suggested.

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

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

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

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

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

Motion unanimously carried and so ordered.

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

Motion unanimously carried.

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

Motion unanimously carried.

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

The society then adjourned sine die.

Deceased Member since last meeting,

Collins W. Walton.

PART II.

PAPERS AND DISCUSSIONS

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

BY EDWIN E. BRYANT.

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

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

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

The power in the government to enact laws in regard to fish, to which this paper is limited, has been repeatedly affirmed by

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

The cases declaring or recognizing this right are very numerous:

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

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

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

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

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

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

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

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

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

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

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

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

V. *The Legislature may Prohibit the Sale of Fish and Game or the Shipment of the same from the State.*—The state legislature, in order to prevent the too rapid destruction of fish and game, have in some of the states, enacted laws to prohibit the shipment of fish or game from the state. These provisions have been the subject of important adjudication. In Magner v. People, 97 Ill., 320, it was held that, as the property of fish and game in the wild state, is in the state, and within the state control, the state legislature may prescribe the terms and conditions on which the ownership may be transferred upon capture, to the individual. And the state may as a condition provide that fish or game so captured shall not be shipped out of the state. The State of Connecticut, in 1888, passed a law that no person should kill woodcock, quail or ruffled grouse for the purpose of convey-

ing the same beyond the state, or should transport or have in possession with intent to procure such transportation, any of such birds killed within the state. This statute was challenged as unconstitutional. The Supreme Court of Connecticut sustained the law, and it went on writ of error to the Supreme Court of the United States. That court divided on the question, but the majority held with the state court, so that the principle may be considered settled that the state can forbid the killing of game or fish except for domestic use. The doctrine was stoutly combated in the dissenting opinion. Mr. Justice Field denied the soundness of the rule that the state was owner to the extent that it could qualify the ownership of one who had lawfully killed or taken the fish or game. He contended that after the capture the property of the captor was absolute, and that he could dispose of the property as he pleased, and that it being an article of commerce, the state could not restrict the sale of it to be sent out of the state. In this view Justice Harlan concurred. Brewer and Peckham did not sit in the case.

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

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

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

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

VI. *The Power of Wardens to seize and destroy Nets in illegal use.*—The legislature may by law declare all seines, nets, set-lines, traps, spring guns, etc., set for the unlawful killing of fish or game, public nuisances, and may authorize the officers to destroy them when found in such unlawful use. Weller v. Snoover, 42 N. J. Law, 341; State v. Lewis, 134 Ind. 133; Lawton v. Steels, 119 N. Y. 226-234. This kind of statute does not interfere with a constitutional right. It is analogous to those that declare it criminal to have in possession counterfeit money or dies or tools for making the same, or the laws which authorize the seizure of liquors kept for illegal sale. Mugler v. Kansas, 123 U. S. 623; Kidd v. Pearson, 128 U. S. 1.

The case of Lawton v. Steels, 119 N. Y. 126 is a leading and important one on this point. It was held by the court of Appeals of New York that the state might declare illegally set nets, when found in unlawful use, public nuisances, and that officers might destroy them when so found and seized. The case then was taken to the Supreme Court of the United States, the contention being that the state law deprived the owner of his property without due process of law. That tribunal affirmed the decision of the New York Court, and Mr. Justice Brown in his opinion discusses at some length the cases where there may be a summary destruction and those in which there should be an adjudication before there could be a destruction of the property. The instances where there should be a condemnation are those where the property is of very considerable value, such as a vessel, teams and supplies in lumbering horses, etc. There are several cases in the state courts, where a technical view has been taken and such laws declared unconstitutional. For example; In Leck v. Anderson, 57 Cal. 251, the summary confiscation of the boats,

nets and tackle was held a depriving of property without due process of law. In Jensen v. State, 7 Ohio Com. Pleas 18, it was lately held that the statute of Ohio, giving the power to any person to take and summarily destroy nets, etc., illegally set and making it the duty of wardens, their deputies, sheriffs and constables to destroy such apparatus wherever found, whenever such officer should *think* it was illegally set in violation of law, was a depriving of property without due process of law.

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

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

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

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

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

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

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

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

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

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

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

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

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

In Wisconsin, the rule of riparian ownership of the soil carries with it the exclusive right of fishing in the waters over such soil has been overturned by the late case of Willow River Club v. Wade, 100 Wis. 86. The club leased the lands for a considerable distance on both banks of the Willow River, an unmeandered tributary of the Mississippi River, which was in times of high

water capable of floating logs and small row boats, though at other times row boats can not be taken up the stream without dragging or pushing them over shallow places. Wade, defendant, entered upon this stream from a public highway which it crossed, and thence went by boat up stream and caught fish by hook and line in a pond the plaintiff, the club, had created by erecting a dam on the stream, for the purpose of widening the stream and making a fish pond of it. The court after a very learned argument, held the stream a public navigable stream, and that the public had a right of fishery in it while passing up and down it, and keeping within the limits of the stream, and not going upon the owner's dry land to get to the stream. This happily settles one phase of the question, but others still perplex the subject of the stocking of the lesser streams.

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

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

State v. Kroenert, 16 Wash. 644;

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

SUGGESTIONS AS TO PROTECTIVE LEGISLATION.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

DISCUSSION OF GENERAL BRYANT'S PAPER.

Mr. John W. Titcomb, St. Johnsbury, Vt.: It is a splendid paper. Every one who has to do with the administration of the laws as well as the work of propagation of fish, will appreciate the importance and value of having the different laws on the sub-

ject so clearly explained; and if it were not for the short time at our disposal, I should like to talk of some facts with reference to the stocking of streams with fish, and in regard to trespass laws. We think we have solved the problem in Vermont.

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

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

Now the state law provided a great many years ago that where a man posted the stream with a poster of a certain size as prescribed by the law, prohibiting fishing and hunting thereon, he could get $10.00 in a civil suit in addition to the actual trespass damages. That law was held to be constitutional. The first embarrassment we met with in connection with that law was the fact that the fish from our state hatchery were going into these waters that were privately posted. We got the legislature to pass a law prohibiting the commissioners from stocking any stream which was privately posted. The result was that at the next session of the legislature the farmers who had streams came in there and said, we don't care a d—n for your hatchery; we don't get any fish; we want the fish in our streams and want to control them. The other faction said, the hatchery don't do us any good, the streams are all posted in our section; and the fight was so hot that the appropriation was held up and there was almost a deadlock on that question. I asked one of the members who was opposing our hatchery appropriation to withdraw a sweeping opposition measure and accept a compromise, which was done. Under the compromise act if a man wishes to have the privilege of obtaining $10.00 in addition to actual damages for fishing on his privately posted waters, he must first stock those waters by

purchasing fish that are artificially reared. He cannot go to public waters to stock them, but must stock his stream at his own private expense from artificially reared fish, and keep it stocked. If we have a stream five miles long and one or two farmers post a mile or so of it, under the old law we could not stock the other part of it; but now the farmers buy their fish of a commercial hatchery and stock the portion they want to, the state stocks the rest of it, and that is open to the public; and the understanding is that if the state stocks any of these streams they are then open to the public. We have in connection with our application blanks question blanks so that we can find out whether the land owners agree to accept these fish from the state and will permit the public to have access to these streams after the fish from the state hatcheries are put in there; and the plan is operating very well. A good many who privately posted formerly have given it up and let the public on, and we stock their waters every year. A good many others are buying fish from the commercial hatcheries.

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

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

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

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

Mr. Seymour Bower, Detroit, Mich.: I want to say a word in regard to one of the recommendations made by General Bryant, and that is in reference to the sale of brook trout by private breeders. It seems to me in a good many of the states we are altogether too severe in that respect. In my state a man cannot buy a brook trout from a private breeder and serve it to the public, in a hotel, without being liable to prosecution. Now in the state of Michigan I have no doubt that within five years, if private breeders could be allowed to put their trout upon the market, we would have twenty-five trout hatcheries at the least calculation, and would be getting fifty thousand dollars to one hundred thousand dollars of good Chicago and St. Louis money every year that we might just as well have as not; and it seems

to me that there should be some practical way to surround the sale of these fish with such provisions as will prevent the sale of wild trout. They do these things, I think, better in the state of Massachusetts than we do in the west. In that state, within a radius of fifty miles from Plymouth, are to be found perhaps twenty-five private trout hatcheries, from some of which five to ten tons of brook trout are marketed annually. They are allowed to sell their fish during the open season in which trout may be caught, and in addition they have a special law that allows them to sell in February and March, and as they have five months of open season, that gives them seven months in the year in which to market their fish. The denial of this privilege or right in Michigan (and I think it is the same in some other states) drives out what might become a considerable enterprise. I see no good reason why the production and sale of trout as a private or individual enterprise should not be encouraged rather than suppressed, no good reason why anyone should not be allowed to sell his own property, and I would like an expression of opinion from others on this subject.

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

the surplus trout we would have that many more eggs, because the eggs would simply go to waste if they did not save them, and thus eggs would be much cheaper.

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

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

The President: But they cannot sell them.

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

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

Mr. C. H. Townsend, U. S. F. C., Washington, D. C.: It seems to me that the effects of legislation on the fisheries and on

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

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

Mr. Geo. F. Peabody, Appleton, Wis.: The work of stocking the waters of Wisconsin by our State Fish Commission has been generously and intelligently done, and not only have the inland waters been stocked and those waters which furnish sport to the angler and the thousands who like to go fishing, but there have

been vast quantities of fry hatched and put in the out-lying waters for the benefit of the commercial fishermen.

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

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

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

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

MAN AS A CONTROLLING FACTOR IN AQUATIC LIFE.

BY DR. J. C. PARKER.

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

Along every avenue of the inorganic he has been a builder. He is the only animal that has ever existed who has left anything besides his bones to mark his place in nature and if by any

convulsion he should be wiped out of existence, and in aeons of ages to come, some creature endowed as he is, should come upon the stage of action, he would still find evidences of his power as a builder.

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

No one realizes better than myself, that there is another side to this question. There has never been a picture painted in words or on canvass of the beauties of companionship with nature, that has not been painted in my soul a hundred times. I know the sweet joy of the vagabond life of the camp: the uplift

that comes from breaking all the conventionalities of daily life: of getting close to the ground, and getting acquainted with its wonderful revelations; of the health renewing strength that comes in the wind that has swept across leagues of water and miles of forests filled with odors sweeter than any perfume: of the worshipful solemnity of the evening camp-fire, when you feel why fire-worship was the first religion: and you sit and listen to the many eerie sounds that come to your city tuned ears out of the solemn woods, wondering what they are and whence they come. And then the preparations for sleep that shall "knit up the raveled sleeve of care" for tomorrow. The splash and splutter of the brands of the camp-fire as you douse it" so that no stray zephyr shall send a vagrant spark into the tinder dry tent, and turn you out in a blaze of terror, and as you sink into the resillient bed of fragrant hemlock, what is the last conscious thought that engages our attention? Isn't it "We're going a-fishing tomorrow!" All the other delights are secondary to this. We take them all in, accept them, as though it was all we came for, and yet we know very well that we wouldn't be there if we weren't pretty sure that we could catch at least a few fish. Of course we are not "fish-hogs," a dozen trout or half as many big black bass would satisfy us, but we would certainly like to kill a few! for that is what we came for after all. No doubt there are those who could get all that has been described and bar the fishing, but I doubt if they ever find their way into societies like this. This brings us face to face with the fact that it is only when we find that these two factors, love of gain, and love of sport have been curtailed through our covetousness or stupidity, that we begin to search for remedies and to ask for the Why! and the How! of things. When commercial fishermen find that the margin of loss and gain, on a trial balance was perilously near the first item, they began to seek some method to rehabilitate former conditions, and when the disciples of Sir Izaak began to find that the streams where they fished when boys would no longer respond to the waving of the "magic wand," when they realized that the "flashing trout" could no longer "rise to the occasion" for they weren't there. And when they asked the old question, "What shall we do to be saved?" And the reply came back, "Sell all thou hast" if thou woulds't go a fish-

ing. Then these too began to ask, Why! and How! To answer these two questioning factions, this and kindred societies have been formed, and through the enthusiasm and wisdom of those who from time to time have thus assembled, some of the problems have been solved, and year by year the How! has been pushed nearer to an answer. To reiterate the story of what has been done, would be to you but an idle tale. You all know what man has taken in that rehabilitation of the waters, from which he has so nearly exterminated their inhabitants. Many mistakes have been made in these efforts, but on the whole, there is I think a perceptible gain, especially in dealing with those waters, over which he can have nearly absolute control, like the inland streams. These he could stock with trout and in them could verify his work. It is the unverified portion of his efforts that is still in abeyance. From the first he has taken so many things for granted that it is no wonder there have been so many failures. If our work is to be recorded as scientific, not empirical, then there should be nothing taken for granted. Science is only an orderly arrangement of facts one fitting into the other like the link of a chain, and to study these from the genesis of life to the revelation of completeness is today the task that is set before the disciples of scientific pisciculture. Our work in the past to which we brought the best that was in us, has been largely empirical, and our reasoning of the a priori order.

When the fact was demonstrated that the ova of certain kinds of fish could be artificially fecundated and hatched, it was then assumed, that if the fry were planted in the waters almost anywhere then the problem of the future supply of the fish was practically settled. So we proceeded to hatch them out by the hundred of millions and dump them into the waters, usually those from which the parent fish had been taken, it being assumed that a large proportion ought to survive to maturity. But somehow there seems to be a hitch either in Nature's plans or our own for after a score of years' trial and a large expenditure of money, we have no assurance that there has been any marked success. In fact we are not *sure* that any one of these hundred of millions has reached maturity. We are not even sure that there has been any particular gain in any one locality. True from time to time our hearts have been gladdened with the reports that the

fish have become suddenly much more abundant, and we have no other satisfying reason, why this state of affairs should exist, and we have concluded that it was through our efforts. But have we been equally fair in our statements of our failures? When a few years ago the whitefish began to be caught in commercial quantities in Lake Erie, after a lapse of many years of depletion, we ascribed this sudden development to the efforts of Ohio, Canada and Michigan, in planting them in the lake. A similar phenomenon occurred in Lake St. Clair in the earlier efforts of the Michigan Fish Commissioners, and we were greatly elated thereat, but of those planted along the eastern shore of Lake Michigan I am forced to say there was never any perceptible showing. Depletion went on with each decade, until today we stand face to face with the fact of an almost fishless sea.

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

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

To point out blunders and grumble at existing conditions,

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

There is another phase of aquatic life to which but little attention, so far as I am aware—has been paid, and that is the plant life of all the waters, of the sea, no less than that of our lakes and streams. As on the land, all animal life is dependent on the vegetation, so in the waters, there could be no organized aquatic life without the primary existence of aquatic plants. In this field, man has indeed been a controlling factor, and may find, possibly, that in the future his best constructive work may be in the study of the growth and conservation of the plant life of the waters. Many times have I known the aquatic life in our inland lakes nearly obliterated by the deepening of the outlet of a lake, in order to reclaim some bordering marsh. If when you are on a lake or stream, you will pull up any of the water plants, during their active summer's growth, you will find them covered with larval or crustacean life. On this small fish feed, and ten large ones on the smaller. And thus the balance of life is complete. Interrupt this in any manner and you have destroyed the delicate poise of the balance. By lowering the water line, the plants will wither and dry up, and with them the life that depended upon them for their sustenance and growth. Then the swarms of minnows deprived of their friendly shelter and food, either starve or become an easy prey to their predacious neigh-

bors, who after having eaten the "fatted calf" cannot find even the "husks to fill up on" and so succumb to the inevitable. I have known lakes in which there was fine bass fishing to become completely depopulated in three years by a foot or two's lowering of the original water line.

To my mind, it is not at all impossible that some disturbing or destructive influence of the flora of our great lakes has more to do with the depletion of its whitefish than the greed of fishermen. I remember very distinctly the surprise that I experienced when I first discovered the food of the whitefish. It was soon after my appointment on the board of the state fish commissioners. I could find no one among authors or practical fishermen who could give me any information as to what they ate. So I made a trip to Grand Haven, at that time having a large interest in the catching of fish. One of the fishermen turned over to me possibly a barrel of intestines, and I started out with a sharp knife, a stout stomach and lots of ignorance to find out what whitefish lived on. I worked diligently for an hour cutting open stomach after stomach but without any result in finding what I was looking for. In nearly every one I found more or less sand mixed with the mucus of the stomach. I finally came to the conclusion that as the fish had been caught in gill nets their detention there had emptied the stomach of all food. Just as I was about to give up for that time I thought I would see how the inside of the stomach looked under a magnifying glass I had in my jacket. Incidentally I looked at some of the sand, when to my intense amazement I discovered that what I had regarded as sand was the shells of a minute bivalve but little larger than a grain of sand and so translucent as to shine as a grain of sand. Of course this was a new world and I commenced all over again, and left with a very thorough knowledge of what those white fish had been feeding on, for there were the shells in all stages of digestion from those recently taken in, to the shell from which the animal had been removed by the digestive process. Still what I found seemed so insignificant to the size of the fish that I thought there might be some mistake so I concluded to remain over night and verify my observation by the next day's catch. I did so with the same results. Then I thought it might be a local matter, and so a few months after I

found my way to Mackinac where I made examinations finding only the same evidence of food in fish caught there. Later in the stomach of a ten pound white fish caught on the south shore of the peninsular, north of the Beaver Islands, I found some shells of the genus Melania and Paludina, shells half an inch in length and one-fourth inch in diameter, but shallow water shells, the habitat of which is well known, but I never was able to find the smaller shells only in the stomachs of the whitefish. I am not aware that they have ever been found in their native habitat, or what the vegetation is on which they feed. Of course it may be begging the question to assume that they are vegetarians but the natural sequence of life, so far as we can demonstrate it would lead us to infer that such was the case and if it is, the fate of this fish is to be determined by the growth and continuation of this plant wherever and whatever it is.

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

DISCUSSION OF DR. PARKER'S PAPER.

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

In the spring of 1897 lake trout fry were planted in Big Averill Pond in the town of Averill, Vermont. Each successive

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

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

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

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

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

The President: And all of the same size practically?

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

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

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

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

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

another, the Great Lakes and Mississippi another, and then the Pacific coast; it takes three or four years to get over the ground.

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

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

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

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

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

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

Dr. Parker: Verification is just what I contend for. They verify those things by taking the shad and striped bass over there. But what I contend is that they do not get the results from planting whitefish in the Great Lakes in proportion to

what has been done with other fish. I say that in all probability we can account for the condition of affairs in Lake Erie by the increased number of fishermen going there for the reason that it is better fishing.

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

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

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

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

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

Dr. Parker: There are plenty there today.

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

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

Mr. Clark: No.

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

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

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

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

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

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

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

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

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

THE INDEX.

BY JOHN E. GUNCKEL.

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

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

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

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

Dr. Theodatus Garlick, Prof. Spencer F. Baird, Prof. G. Brown Goode, Judge Emory D. Potter, Col. Marshall McDonald, Fred Mather, Herschel Whitaker, Henry C. Ford and many others whose names and valuable works you will recall. Around these men circle memories that time cannot efface. These men were leaders in biology and general scientific researches. To them and their associates the American people owe much; more than a memorial tribute of words. They discovered and harvest-

ed fields that many of us today are but gleaners. In the life of this society the road was discovered that is leading rapidly to the solution of great problems in nature's marvelous works. Fish can now be artificially hatched with more success than nature gives to the fish in their natural elements. The hatching facilities of every state in the union should be so enlarged and improved that millions of young fish can be planted every year of our most important food fishes. This is helping mankind. To-day the life of each inhabitant of God's creative waters is known to the fish culturist and biologist from the fry and fingerling to the self-supporting fish, and all diseases known to fish from the trout down to the palatable cooking of our much abused German carp. In the memory of all of us, who have watched the interests of this society, we recall the papers and discussions giving the results of hard labor and untiring study in detail of the successful hatching and caring for almost every species of our food fishes.

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

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

What of the future?

In the index of today we find the members of this society are branching out in other pastures. Some are endowed with talents

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

Again, the medium through which the public is benefited from the results of the labors of individual members is the record of transactions. It is an honor to this society, a great credit to Secretary Seymour Bower, for the complete and general arrangement of the report for 1900. Would it not be well for this society to go still farther in their annual reports by following New York's most elegant official report of the State Fish Commission? A volume more complete than our present form would be an everlasting honor to our society. In glancing at the many papers and discussions of men like F. N. Clark, C. E. Brewster, H. W. Davis, George F. Peabody, A. N. Cheney, Prof. A. D. Mead, Hon. Eugene G. Blackford, W. DeC. Ravenel, Hon. George M. Bowers, J. W. Titcomb and many others we are not surprised to learn that they are uniform in one belief that great problems of the future increase of our food fishes center in the success of what is now in progress by active members of today who are to read papers and discuss this new movement. No man is better able to tell us what is required of our legislators to guarantee to the people, "Practical Protection and Perpetuation of our Wild Life," than our esteemed Grant M. Morse, Michigan's State Game Warden. He has carefully studied the past and concludes that there is but one way to make this a success. He argues that men and fish are now one, that fish planted in the lakes and streams hatched by members of this society feel as if they were under obligations to their friends—the fish culturists. Therefore, he will suggest that fish should be requested not to feed upon their kind, not to enter a net or trap, or other evil devices of man, and do away with "Uniform General Laws." This idea is sanctioned by one of our oldest and most revered members, Dr. J. C. Parker, for he is satisfied that, "Man is a controlling factor in aquatic life." We have had hints of this

coming event from the studied pen of F. N. Clark, who, back in the nineties declared that, "Fry and Fingerlings one day would form a trust which would unite the food fishes of our waters." C. E. Brewster also told us that, "There will come a time, some day, when fish will understand each other." Seymour Bower, who knows every fish by name is recorded as saying that, "Fish in our Michigan waters have been casting Goo Goo eyes at each other to beat the band." Dr. James A. Henshall who is studying the habits and dispositions of our mountain stream fishes said, in the long ago, "In the study of the black bass we are convinced they are leaders and at no distant day will they unite in a powerful combination for self protection." Georgia's famous fish culturists through J. Bayard Lamkin in his paper on, "Feeding of Black Bass Fry" and J. J. Stranahan, late of Ohio, have come to the conclusion that to, "Prevent Cannibalism in rearing black bass," is to teach them in their fingerling years to eat Georgia watermelons and other carp nourishing delicacies. There is a unity in this problem even after death, for S. P. Bartlett, Illinois' carp champion, in his "More About Carp" will tell us that there has been no fish ever discovered in ancient or present times which can be served in more courses and under more different names than our Illinois carp.

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

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

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

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

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

THE BROOK TROUT DISEASE.

BY PROF. M. C. MARSH.

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

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

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

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

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

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

These boil-like elevations are not boils nor abscesses proper, for they do not contain pus and the infection is not a suppuration. Their contents are a bloody liquid which consists of the serum of the blood, some red corpuscles and a good many white ones, degenerated muscle fibres, and countless numbers of bac-

teria. There is no excess of white blood cells as would be the case if pus were present.

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

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

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

Prevention suggests the question of the original source of the infection. Where did it come from, how did it get into the trout, and how may it be kept out? The original source is perfectly obscure at present, and may always remain so. The presence of the infection is more apparent than its origin and destiny. Yet there are some general considerations which have a bearing. There was a time, at Northville for instance, when these epidemics did not occur. It is unlikely therefore that the specific germs were normally and constantly very abundant. They were either constantly present in the environs of the ponds in small numbers, or at some time they became temporarily numerous. In the former case their constancy, in the latter their numbers, en-

abled them to gain the foothold in the brood of fish. Of course the virulence of the organisms is another factor which enters in. The foothold is the important thing. Now, where were these germs before they got inside the trout. The air contains many bacteria. But it is the less likely hypothesis that they dropped into the ponds from the air and then found their way into the fish. There is the soil and water, and if either of these it is of course ultimately the soil. This is a more reasonable supposition. Books on bacteriology have long lists of species of soil organisms. It is readily conceivable that some of these species, in the earth immediately surrounding the springs, conduits, or ponds of a trout hatchery entered the water and lodged within the body of a trout and found its blood and tissues so favorable a home, that whether or not it had ever been parasitic before, it now became so. It is readily seen that the mouth would be a probable avenue of entrance. The germ having entered the water is apt to be taken in with food of any sort. It is smaller than most of the body cells and can make its way into tissues between these cells. It can enter through abrasions anywhere on the exterior of the fish, through breaks too small to be seen, possibly through the intact skin. Theoretically one bacterium and one trout are sufficient for the start. The rest is easy.

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

This brings us to what I may call the wooden pond theory. Wooden, because the ponds have usually wooden linings, but earth or other pervious material comes in the same class with

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

We must consider briefly that part of the fish cultural water system above the ponds,—the part usually not inhabited by the fish. You will remember I made a distinction between the danger of the primary or original menace of infection and of the secondary or localized one. The former was looked upon as less dangerous but was responsible for the first epidemic. the latter as far more dangerous and almost certain to infect, and implied the continuance or recrudescence of the disease. This distinction corresponds on the one hand to the water supply above the ponds and free of fish, and on the other hand to the pond system itself in which the fish are held. The demarcation is at the point of entrance of water into the pond. Below this line, or in the ponds, the danger of infection is the same as that above plus the localization from previous epidemics. Bacteria probably do not travel up the conduits, so that above this line of demarcation the danger is that which always existed there, namely that some obscure chance or accident may start the ball of disease rolling by

introducing infection into the water. At this point it may occur to you to ask why, if the cement construction is a barrier to infection, can it not be continued up the conduits and into the springs and make the water system impregnable? The objection will as readily suggest itself. As far as the conduits are concerned this would be excellent, but when it comes to the spring that of course must be left sufficiently open to deliver the water. These openings would defeat the main purpose of the cemented spring. It is a case of a little leaven leavening the whole loaf. The cement here might be of some value, but if infection underlies the spring the water would carry it in. If the water entering a cement lined spring could be filtered free of micro-organisms there would be complete protection in association with cement ponds from infection through soil or water. But this degree of safety cannot be attained. As for the prevention of disease by the use of cement or stone, we must count on the application of these to the ponds alone as so nearly covering the whole source of infection as to offer reasonable hope of accomplishing the prevention. This means that the pond infection is so large a part of all the infection to which the trout are exposed, that protection from it will mean protection from disease,—except, no doubt, the occasional outbreak. The danger of an occasional outbreak is a risk which must be assumed. At Northville, during the past June, the fry in the troughs in the hatchery commenced to die of the disease which was among the yearlings in the ponds out of doors. This is the first time in some years that serious trouble has occurred with the fry in troughs, and perhaps the first occurrence of this particular disease in the troughs. At first this seems to militate against the pond theory, for the trough supply water comes directly from a large spring above the ponds. But this spring is practically a fish pond, for trout have been kept there from time to time, and while disease has not been noticed there it is not improbable that it has occurred. There is always considerable loss from such ponds, part of which is due to depredations. But it must be remembered that fish dead or dying from disease would be apt to be quickly appropriated by birds and animals, or to be lost to sight in the vegetation, the conditions in this respect being quite different from the

small wooden ponds where every fish is in plain sight at all times.

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

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

and with this domestication is largely inconsistent, because there must be considerable divergence from natural conditions.

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

At one station the disease was checked by the transfer of the trout to certain large earth ponds which contained an abundance of natural vegetation. In fact most of the conditions to which wild trout are subject were supplied by these earth ponds. They were very much larger than the wooden ponds. Now I believe there was more prevention in this than cure. The unaffected individuals merely failed to take up the infection, and the chief factor that enabled them to avoid it was the *dilution* of the infection, and the previous freedom of the pond from infection. It was somewhat like returning the trout to a natural stream. They separate, there is more space between the individuals and there are fewer germs to each cubic unit of water. Many fish within a small space is of course a necessity in domestication. This is a

very important factor in the transmission of disease, perhaps the determining factor in its control. The fish are crowded from the standpoint of disease though not from that of aeration. One naturally wonders whether wild trout ever suffer this disease. The attempt has been made to follow the history of trout distributed from the hatchery, but no evidence of mortality could be obtained. In the wide range afforded by the natural streams lies the safety of the wild fish. Yet it will not be very surprising if the disease is sometimes found in the trout streams.

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

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

bar out the germs. It is hoped that cement ponds will be an adequate barrier. The predisposition will remain. It is hoped that the brook trout will thrive in spite of it.

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

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

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

DISCUSSION OF PROF. MARSH'S PAPER.

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

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

Mr. Bower: Prof. Marsh rather intimates that where the

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

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

ones, for you cannot disinfect them with chemicals. The cement pond acts merely as a barrier against infection, and, as Mr. Bower says, it might in some way predispose to other diseases; we do not know about that. It is untried and the experiment must be made. I do not see how it could predispose to some other disease than the one we are trying to prevent.

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

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

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

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

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

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

The President: None of them have stone or cement; they

are all natural earth banks or they are wood, and yet they never have the disease.

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

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

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

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

The President: Yes.

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

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

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

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

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

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

Prof. Marsh: Was it brook trout?

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

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

Mr. Mathewson: That was our experience this year.

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

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

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

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

The President: This discussion is very interesting to the Michigan Fish Commission, because we have just secured an

appropriation to build a new hatchery, and they have not started it yet.

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

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

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

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

Prof. Marsh: No ulcers or sores?

Mr. Mathewson: No.

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

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

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

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

you are as badly off with cement ponds as you are with wooden ponds, but happily this original infection will probably be comparatively rare.

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

Prof. Marsh: Yes, sir.

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

Prof. Marsh: Yes.

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

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

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

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

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

Prof. Marsh: Yes.

THE STUDY OF FISH DISEASES.

BY CHAS. G. ATKINS.

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

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

I may be pardoned for digressing here far enough to say that in the course of a lifetime spent in this pursuit, I have often had occasion to note that the bane of fish culture has been the disposition to jump at conclusions. It is a trait of human nature. Hardly one of us is free from the foible, and hardly one of us but is suffering today from the effects of some mistaken conclusion reached in the past by disregarding some pertinent facts that, if not plainly in sight, might have been easily brought to view by a little more of persistence in the search. Private fish culture and public fish culture are suffering from it today. There has been too little of the scientific spirit. And science, I

beg to remind you, does not consist essentially in a knowledge of the Latin names of fishes or the minute anatomy of an insect. Such things are not to be despised, but they are only aids and means to something of greater importance; and a man may possess either or both of them and yet be less scientific than a humble layman who holds his eyes and his mind open for the acquisition of new facts, and faithfully restrains his opinions from crystallizing on any half-knowledge.

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

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

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

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

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

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

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

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

6. Fungus on the egg.

7. Fungus on fry two to four months old.

8. Fungus on adult salmon.

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

10. Trematode parasites on young lake trout.

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

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

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

One of the most interesting cases was that of the young lake trout attacked by parasites in 1896. These fish had been hatched from eggs received from Northville and had apparently been thriving until about the middle of July, when there was a slight increase in the mortality. A week later the rate of mortality had trebled and by the 10th of August it had increased more than tenfold. At first it was thought possible that the mortality was due to fungus, and the fish were treated with salt. No benefit resulting, the microscope was brought into use and behold the fish were swarming with living, active parasites, which moved about over the fish after the manner of loop-worms or leeches,

apparently the creature that has been described under the name of Gyrodactylus elegans. In hope of destroying the parasite, the salt treatment was continued, but it was found at last that the parasite could endure quite as much salt as the fish itself. Mr. Seagle at Wytheville, has since discovered that this parasite is readily destroyed, with entire safety to the fish by a bath consisting of one part common cider vinegar, three parts water. The mortality went on until the sufferers had shrunk from 39,000 July 1st to 10,000 in November, and the survivors were fish of low vitality, of whom probably not one ever grew up.

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

The most destructive disease that has ever come under my observation was the sac-epidemic which raged several seasons at Craig Brook and in 1892 destroyed 99 per cent. of our young Atlantic salmon. I call it "sac-epidemic" because it raged during the sac stage of the fry, and because the most obvious symptoms were connected with the sac. It would appear about midway of the sac stage, while the sac was still less than half absorbed. In water of constant temperature, such as pure spring water, I imagine that the disease would appear by the first quarter of that stage. Our water is very cold at the time of hatching —about April 1st,—and gradually warms up, so that the development of the embryo is at first very slow and later comparatively

rapid. The fry hatch about April 1st, and before the end of April, in epidemic years, the mortality suddenly increases, and it is found that the sacs of the fry are blotched with white. These blotches spread until the sac is nearly all white, especially the apex. When it reaches this stage, the fish dies. Other symptoms are apparent listlessness, indifference to light and outside movements, and in consequence a scattering about on the bottom of the trough instead of crowding into the dark corners as is the normal habit of the fish.

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

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

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

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

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

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

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

our suspicions in the direction of the spring water. Measures were taken to insure a fuller supply of lake water during the stage following and immediately preceding hatching, and this has been attended with favorable results.

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

DISCUSSION OF MR. ATKINS' PAPER.

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

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

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

Mr. Bower: Mr. Atkins enumerates in his paper thirteen different diseases. It looks to me as though the trout culturist has a pretty hard row to hoe, and it seems that new diseases are coming up all the time, or at least old diseases under new names,

and it all emphasizes the necessity for great vigilance on the part of the fish culturist and the constant employment of a scientist to work on these subjects.

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

THE PROPAGATION OF MUSKELLUNGE IN WISCONSIN.

BY JAMES NEVIN.

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

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

Under these circumstances it has devolved upon the State Fish Commission to attempt the preservation and increase of

muskellunge in our waters, and it is much to be regretted that this work was not begun several years ago.

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

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

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

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

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

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

logs, and brush have accumulated as the result of flooding for logging purposes or otherwise.

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

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

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

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

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

Heretofore, we were not in position to try hatching muskellunge eggs in jars. This year our work was conducted in the vicinity of the Minocqua Hatchery, and I placed part of the eggs in Chase hatching jars at this station. The remainder, being more than half the eggs, was put in hatching boxes and sunk in some four feet of water. We hatched a very small per cent in boxes, but were more successful with the eggs incubated in jars. Just before the eggs began to hatch, we took them from the jars and placed them on trays made of fine wire-cloth. This was

done to prevent the young fish smothering; for I found that the fry would not make their way out of the jars unaided on account of the comparatively large umbilical sac.

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

We planted 500,000 fry.

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

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

DISCUSSION OF MR. NEVIN'S PAPER.

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

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

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

EXPERIMENTS IN LOBSTER CULTURE.

BY DR. A. D. MEAD.

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

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

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

Not the least remarkable of the altered characteristics of the fourth stage is their mental attitude. Upon entering this stage

they are born again, they know good and evil; for the first time the sense of fear is evident, and they retreat from danger; there is, in short, a purpose and direction in their activities which was not apparent in the three earlier stages.

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

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

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

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

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

4. What is the best method of supplying food?

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

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

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

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

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

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

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

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

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

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

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

what they come in contact with; and as they are continually moving about in an ocean full of organisms, they must but rarely want for food.

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

4. What is the best method of supplying food?

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

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

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

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

There are two main difficulties in the way of providing a suitable enclosure for the fry which will allow them sufficient freedom, and which will at the same time confine them and protect them from their enemies. The fact that the young fry swim about and are carried hither and thither by the currents consti-

tutes the first difficulty, for when they are placed in an enclosure provided with a screen which will allow a free circulation of water from the outside, but shuts out the enemies, the fry are carried against the screen and die. The second difficulty is quite as serious and is due to the fact that at certain times the fry have a tendency to leave the surface and sink to the lower depths.

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

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

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

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

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

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

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

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

The results obtained by the use of this apparatus were certainly very gratifying to anyone who is at all acquainted with previous experiments along this line. In order to ascertain exactly what proportion of the fry could be reared, they were carefully counted one by one at the beginning and at the end of each experiment. From 1,000 to 5,000 of the newly hatched fry were put into one cage and the percentage reared to the fourth stage was in no case less than sixteen except in one case when the bag was torn and the fry escaped. One experiment yielded 34 1-2 per cent., one 40 per cent., and one of the later experiments 50.6 per cent.

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

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

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

PRACTICAL HINTS ON FISH CULTURE.

BY DR. JAMES A. HENSHALL.

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

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

AERATING SCREENS.

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

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

After being convinced of the inefficiency of the aerating screen as usually made, I devised one that fully meets all requirements. It is constructed as follows: A piece of soft roofing tin of the desired size is marked with lines an inch apart, both ways

of the sheet, and tacked on the frame. Where the lines cross, at right angles, a hole is made with a six-penny wire nail, from the inside of the screen. Thus in a screen of ten by twenty inches, inside measurements, there will be 200 holes. In driving the nail through the tin a shallow dent or depression is made around each hole, while on the under side the hole has a ragged or broken edge.

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

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

FEEDING FRY.

I wish to call particular attention to the remarks of Mr. W. T. Thompson on the subject of feeding fry, which may be found in the proceedings of this society for 1900, pages 143-146. I wish to indorse and emphasize what he says concerning the feeding of fry before the yolk-sac is absorbed. I first adopted the plan of feeding grayling fry as soon as hatched several years ago, and afterward trout fry in a similar manner. My plan is to feed the bloody water from finely ground and screened liver, by placing it in the horizontal aerating screen at the head of the

hatching trough. While no particle of food may be apparent to the naked eye in the bloody water, it is there, nevertheless, and it is carried along with the water at the bottom of the trough, where the fry soon learn to appropriate a part of it as it floats by them. Coral polyps and other marine invertebrates that are not free swimmers depend entirely for their food on the passing current—food that is not visible to the naked eye, but shown by the microscope to exist in great quantity.

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

DISCUSSION OF DR. HENSHALL'S PAPER.

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

Mr. Titcomb: We formerly planted our fry before the sac is absorbed and before the snow water is out of the stream. We would put them in some times, and I have done so a great many years ago, when our team was carried over the hill on top of four or five feet of snow, on a crust that would sustain horses and everything, and then when we got to the stream, we would slide

the tank down on the crust and get to a hole where there was enough current to keep it open and there deposit our fry. I do not believe in that method, although I know that the fry just before the sac is absorbed are more easily transported than just after. I do not believe in planting the fry just after the sac is absorbed. I agree with Mr. Clark on that point. Therefore we keep our fry until they have been fed for six or eight weeks at least, before planting them.

The President: After the sac is gone?

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

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

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

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

BY C. C. WOOD.

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

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

But in what does the purity of the water consist?

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

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

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

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

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

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

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

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

through weeds and water plants, where it might absorb nature's elixir of life, and perhaps give up some of the elements peculiar to itself when starting at the source.

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

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

Next morning upon inquiring how the fry were getting on I was surprised at being told that soon after being put into the pool they had commenced to die and only quick work saved a portion of them. Noticing that they were acting strangely and turning up, the purchaser who was a practical sort of man, made a temporary place for the fish in a box by knocking out the ends and covering with netting, then transferred the fry to this small

box placed in a stream of water not ten rods away, where they fully recovered, and when I saw them next forenoon were as lively and as smart, crowded thickly in their close quarters as they were, as when I started them on their journey the previous day. I doubt very much if an analysis of the waters from the spring and stream would have shown the vital difference in quality, proved beyond question upon trial.

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

I might mention several other cases of the almost total loss

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

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

them to the yearling age, for the mere hatching of millions of trout and retaining them during the yolk sac period only, is a small achievement compared with the raising of one-tenth of the number to a year old.

DISCUSSION OF MR. WOOD'S PAPER.

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

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

Mr. Clark: I take it from Mr. Wood's paper that it turns more upon the kind and quality of water. Of course, as you are aware, I have had considerable experience in trout culture and fish hatching for quite a number of years. Now I just want to give you my ideal of water for a hatchery: It is to have two kinds of water, as we have spring water, and either creek or lake water. In having the two, which range during the hatching season from 32 1-2 to 46 or 48 degrees, we are enabled by mixing the water to control and regulate the temperature, determining

to a great extent the period of incubation—especially with our lake trout—turning out the fry at such intervals as are convenient for distribution. In other words, fry from eggs of the same age do not all hatch at the same time, some being retarded by colder water. At Northville we can distribute fry for two months—holding them right in the hatchery—and never plant any with the umbilical sac completely absorbed.

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

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

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

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

Mr. Clark: There is not a single place in all the transac-

tions of the American Fisheries Society, or in any of the reports ever given by me to the United States Fish Commission, where I have ever written or said anything advocating the rearing of all the fish that are hatched—never.

The President: To fingerlings?

Mr. Clark: No, sir.

DISCUSSION ON CARP.

LED BY DR. S. P. BARTLETT.

Dr. Bartlett: From a practical standpoint I want to say to you that the United States Fish Commission builded a great deal wiser than it knew when it introduced carp in the waters of Illinois. I am here as representative of the United States Fish Commission, and I want to say to you that the waters of Illinois have proven more acceptable to carp than many of the other waters. I want to speak of that of which I know. The work of the Fish Commission depends entirely of course upon the money they have to run their business. It is getting to be practically a matter of dollars and cents, this Fish Commission business, and ought to be in the various states, but that is particularly true in Illinois. There is, perhaps, no one here that has been a stronger advocate in years gone by of protection than myself. I early made up my mind that any law the enforcement of which would kill a fisherman was next to gospel. I have changed my mind as to that considerably and believe now in propagation rather than protection. The last legislature of Illinois enacted laws which prohibit the taking of black bass, wall-eyed pike, etc., except with hook and line during the whole season. The carp on the other hand have been subject to a little more of the open season and are permitted to be caught more months in the year. I want to say to you briefly, however, and without giving you any reasons for it, because you all know what my reasons are, that the carp have produced in the State of Illinois more money than all other fish put together. That seems like a pretty hard statement to make, but it can be verified, and I want to say to you that there are more carp eaten on the hotel tables in the State of Illinois than any other fish. I have been served with "red snapper" which turned out to be carp. This cry against the carp is a great big humbug—it is an outrage—they are a good fish if you know how to cook them, but not so good if you don't know how. Most of you are men of leisure and like your black bass and whitefish, but what about the one dollar and ten cent a day man? He has

got to take carp. Illinois produced three quarters of a million of dollars in coarse fish last year. It would be as much as your life is worth to take a trip down to the Illinois river and tell the men there that carp is not a good thing. They would take you out and duck you gracefully into the river. More than one-half the towns on the Illinois river depend mostly for their existence on the fish industry, and considerably over two-thirds of the fish taken are carp. They grow anywhere and everywhere; they grow with the black bass, and the black bass are as plentiful as ever. Illinois can furnish one-half the black bass for stock in the United States, and yet there will be no diminution in quantity. We take just as many black bass with the hook and line this year as ever, while the carp are steadily on the increase. I have no patience with the newspaper talk that says that the carp are an enemy of the game fish. I do not believe anybody can prove it. I would like to hear it if it is so.

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

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

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

Mr. Townsend: It may be that the carp has been introduced in some places where it was not needed, where other kinds of fish were more important; it might not be advantageous to introduce the carp into the beautiful little lakes of Mr. Peabody's state; but there are many waters in this country teeming with carp, and people are finding out in many places that carp is a food fish. There is a market for carp in the big eastern cities and carp will sell there. They sometimes sell even for a high price; generally

they sell for a low price and are bought by poor people. There are many foreigners in our eastern cities that are steady consumers of carp, and take all that come to market. Carp go to market generally in good shape; they can be packed in ice in Illinois and will reach New York alive. If they are properly cooked they are very good fish.

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

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

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

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

In New Jersey the carp have taken to living in the slightly brackish water, and most of the catch comes from those waters which lie between the more salty bay waters and the fresh waters. The carp there are in places where they appear to hurt nothing, and they are beginning to find their way to market. If I had a

big lake I should not hesitate to stock it with carp, and I should expect it to pay before very long.

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

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

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

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

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

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

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

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

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

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

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

Our Illinois river is really a series of lakes from one end to the other. The river itself is anywhere from seven to fifteen miles wide, and there is a considerable chain of lakes or low places on either side of the river, extending the whole length of

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

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

introduced in the state of Illinois, the buffalo having become almost extinct in our waters although it was once the great commercial fish that the bass would have been gradually taken out entirely from the list. As it is now, I want to repeat the statement that we have more black bass than ever, and our carp certainly have increased in a greater ratio than ever before.

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

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

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

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

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

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

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

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

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

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

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

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

Dr. Bartlett: I should think so.

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

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

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

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

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

Dr. Parker: I wish to say just a little bit in regard to this matter. The carp is the most omnivorous of all fishes. He is a hog and will eat everything. He will eat spawn if he gets it, but I do not think he will search it out. I believe, as the president

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

Mr. Clark: Yes, he would.

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

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

or three pound bass runs his dorsal fin against a fifteen or twenty pound carp, Mr. Carp will move off, if he is not dead.

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

tainly have a strong auxiliary right hand to help us. (Applause).

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

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

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

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

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

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

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

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

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

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

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

There is one other question which comes up very often and which I think has never been answered and I would like to see

a paper on it if anyone has an opportunity to study into the subject, namely:

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

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

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

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

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

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

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

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

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

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

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

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

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

Dr. Bartlett: The state of Illinois presents exactly that feature in the spawning of bass—you will find their nests everywhere from gravel to simple mud. Fifty-one thousand small

black bass were taken from a place in a pond where there is no gravel, but a black loam mud running from twelve to twenty inches deep.

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

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

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

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

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

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

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

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

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

Mr. Lydell: I have had that same condition.

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

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

Mr. Bower: On Lake Erie in the month of June they get down as low as $10 a ton. That is all the fishermen get out of them. I have clippings here that show that statement to be true. They have hard work to find a market for them at $10 a ton. Is

that state of things due to the fact that it is the wrong season, or are the Illinois fish of a better quality.

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

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

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

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

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

Mr. Downing: A little less than now.

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

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

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

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

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

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

Dr. Bartlett: It goes through pretty solid.

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

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

Mr. Nevin: How would carp be if smoked?

Dr. Bartlett: Good.

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

Dr. Bartlett: All large-mouthed.

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

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

Mr. Lydell: A small-mouthed bass.

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

CONCERNING FISH LAWS IN ILLINOIS.

Urbana, Ill., June 28, 1901.

S. Bower, Esq.,
Secretary American Fisheries Society,
Detroit, Mich.

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

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

These exigencies inspired the commission to seek a remedy in the legislature by having introduced a new measure, the one to which I have already referred as coming into effect July 1 prox., a measure much better calculated to cope with the situation. After

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

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

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

Another feature of our new law which we regard as of vital importance is the provision which prohibits the taking of bass with

any device other than hook and line, thus making the angler the sole beneficiary of this species.

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

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

least to distinguish Carp when properly prepared. Suppose we grant that it was a mistake to introduce these fishes into our waters, is it not better to take them also under the protection of our laws, to regard them as a real money producer and a source of cheap food for a large class of our people, since all this can be so readily accomplished without detriment to our game fishes?

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

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

Very sincerely yours,

NAT. H. COHEN,

President Illinois Fish Commission.

STURGEON HATCHING IN THE LAKE CHAMPLAIN BASIN.*

BY LIVINGSTON STONE.

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

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

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

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

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

The difficulties did not prove wholly insurmountable, however. All the fishing for spawning sturgeon had been done, this year, on the Missisquoi with nets. On the Lamoille, we encountered something different. Near the south bank of that river, about four miles from its mouth, and half a mile from the West Milton postoffice, Vermont, is a place known to the residents of that neighborhood as the "Sturgeon Hole." Here the main body of the river rushes through a rocky gorge not over twenty or thirty feet wide, with precipitous walls of solid rock on each side. Just below the gorge is a hole about forty-five feet deep, apparently shaped somewhat like a boat, in which the spawning sturgeon collect, usually very soon after their appearance at the mouth of the river, but most probably when the water reaches

the right temperature for spawning. The water is too deep to spear the fish here and nets cannot be used, but the sturgeon are taken by twitching them up with hooks. We watched this hole night and day, after the appearance of the sturgeon at the mouth of the river, and obtained many breeders from the "Hole" after they had begun to collect in it, twenty-seven being caught on the 22nd of May, the temperature of the water being 68 degrees F. These were all or nearly all ripe males, but on the afternoon of the 23d of May too entirely ripe females were hooked up. The fish not struggling violently at first, the men stopped the flow of eggs by stuffing their handkerchiefs into the vent. The fish were then towed across the river, where the males had been secured, and were instantly killed by being knocked in the head. Their eggs were taken and treated like pike perch eggs, as to impregnating, mixing with milt, rinsing, etc.

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

great success, instead of which we were on the eve of a great failure.

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

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

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

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

Allow me to state in conclusion, as I have already done, in

my annual report to the United States Commissioner of Fish and Fisheries, that the following points in regard to Lake Sturgeon and Sturgeon hatching may be considered as pretty well established:

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

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

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

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

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

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

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

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

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

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

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

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

NEW PENNSYLVANIA LAWS FOR THE PROTECTION OF FOOD FISH.

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

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

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

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

for the future protection of the beautiful and delicious denizens of our noble rivers and lovely mountain streams.

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

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

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

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

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

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

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

THE USE OF NETS AND OTHER DEVICES.

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

Section 7. Lawful to use dip nets, spanning five feet, two inch mesh, except in trout streams, during March, April, May, October,

November and December, for carp, suckers, catfish and eels. Other fish to be returned. Penalty, $10 each fish and forfeiture of nets, etc.

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

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

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

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

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

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

FISHWAYS, SCREENS AND OBSTRUCTIONS.

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

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

Section 15. No fishing except with rod, hook and line within one-fourth of a mile of a fish way, and no obstruction to be placed

which will prevent free passage of fish. Fine, $100 and forfeiture of all devices used.

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

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

REGULATING SALE OF GAME FISH.

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

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

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

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

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

IN RELATION TO TRESPASS.

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

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

DISTRIBUTION OF FISH AND PUBLIC WATERS.

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

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

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

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

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

GERMAN CARP UNLAWFUL FISH.

Section 26. Unlawful to fish with any poison or explosive, and no explosive shall be used in waters except for engineering pur-

poses, after written permission is obtained from proper national, state, city or county official. Fine, $100 and imprisonment for six months.

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

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

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

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

OTHER FISH THAN THOSE SPECIFICALLY NAMED.

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

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

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

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

Having thus made plain the laws regulating the catching of the food fishes which have been considered of sufficient importance to require the attention of such a body of men as the government now upholds, it was deemed advisable to form laws to

guide such officers as were required for the maintenance of these codified laws, therefore the following laws were adopted showing clearly the officers and their duties; we quote in full:

DUTIES OF FISH WARDENS AND OTHERS.

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

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

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

DISPOSITION OF FINES.

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

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

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

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

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

FISH COMMISSIONERS.

Section 41-42. The Governor shall appoint six Fish Commissioners, who care for the fish cultural and protective work of the

state. They have power to enforce the provinces of the act, to appoint fish wardens and issue bulletins on fish cultural matters.

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

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

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

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

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

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

BROOK TROUT NOTES.

BY W. T. THOMPSON.

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

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

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

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

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

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

Transferring from trough to pond. One great drawback that the young fish culturist experiences is the difficulty of finding recent text books. Our authorities are largely out of date, their methods obsolete. Quoting from a standard authority: "The rearing ponds are stocked gradually, 500 to 1,000 being placed in the pond and trained to take food before more are added, as that number can generally find enough food to subsist upon until they learn to take artificial food. When they have been accustomed to hand feeding, another 1,000 fish are added

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

When will the harvest be? No question is more frequently asked than: "How many years does it require for these little fellows to get big enough to catch?" It is both a reasonable and practical one, and yet it is one that is rather difficult to answer definitely. It is one I ask of the members of this society. "How long does it require to grow a fish of angling size from fry?" Two years? Three years? In New Hampshire they will tell you "One year." Qualifying it however by adding: "Under favorable conditions." For two years past the sporting papers as well as the local press of New England have been full of the great loss of trout throughout that section caused by the unprecedented drouths of 1899 and 1900. Many stated that there would be no brook fishing within three years, others took even a more gloomy view claiming that it would require a greater

period of time simply to replace the brood stock. Never was there a more favorable time to thoroughly test the value of planting and at the same time to answer the above question by a practical demonstration. In the spring of 1900, the United States Fish Commission made heavy plantings of large, vigorous, well fed fry from one to two inches long, followed by a summer distribution of two to four inch fish and winding up in November and December with trout some of them even then above the usual five and six inch limits. This work had been done so quietly that few other than those actually engaged in the distribution and planting were aware of this new factor. Hitherto nothing but unfed fry had been planted. The arrival of the open season scarcely created a ripple of excitement amongst the anglers. Conditions and results though are best described in the accompanying letter from Mr. W. H. Beasom, a prominent citizen and former mayor of Nashua, as well as an ardent sportsman.

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

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

Dear Sir:—For the past twenty-five years, with possibly three or four exceptions, I have fished for trout in the brooks around this city. During this period the number of anglers has increased to such an extent, that about ten or twelve years ago, I came to the conclusion that nothing except regular and intelligent restocking of the brooks would save the trout from extermination—or at least diminishing the supply to such an extent as to make angling a doubtful luxury. In company with a friend, Mr. Geo. F. Andrews, I applied for fry from the state hatchery, they were distributed and each year since I have with Mr. Andrews or others planted from 15,000 to 25,000 annually. If I had any doubts as to the benefits of restocking—which I did not—they would have been removed by the results of this season's catch. The seasons of 1899 and 1900 were extremely dry ones, some small brooks drying up for nearly their whole course, while others were dry for quite long intervals—as I found when woodcock shooting in October, I did not see any dead trout, but it is fair to assume that many died as our trout are not good tree climbers. During 1899 the streams had a good supply of fry planted—but as I recollect it, the fishing of 1900 was below the average—or at least not very good. In the summer of 1900 (Note, Aug. 8), the United States Government Hatchery had a quantity of fish measuring from two to four inches in length which I had the pleasure to assist in planting in nearby streams. All previous plantings had been fry about one inch long. The fall of 1900 was even

dryer than 1899 and fishermen were apprehensive of results this year. To our surprise and pleasure, the fishing has been better this season than for years past, especially as to size of fish. A larger number of trout weighing from one-half to one pound has come under my notice than for years—while a large number running from six to nine inches have been caught. In fact any one with a knowledge of fishing can get a few of fair size nearly any day. In speaking of a well known and much fished brook, one of our oldest anglers said: "I have known and fished that brook for twenty years and never knew the fishing to be better than it is today." Now one swallow doesn't make a summer—but my personal opinion is that this extra fishing after unfavorable conditions is largely, if not entirely, due to the planting of well grown hardy fish instead of the fry usually distributed. To be sure fry were planted as well, and I firmly believe fry planting to be of value, but if we could have from 25 to 33 per cent. of the total of fry in well fed trout from two to four and one-half inches long, I firmly believe the results would be more substantial in every way.

Yours truly,

(Signed). W. H. BEASOM.

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

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

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

Dear Mr. Thompson:—Yours of June 28th, at hand. The pond I stocked last fall with fingerlings was made by building a dam across a ravine. There had never been a trout or fish of any kind in the

stream above the dam before. We have some trout in this pond from this planting that will measure ten inches. I am sure they will average seven inches. They are nicely colored and very fat, showing there must be plenty of food for them in the pond as we have not fed them.

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

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

N. WENTWORTH.

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

The brook trout holds a unique position amongst fishes, somehow this "speckled beauty" has a most peculiar and tender place in our affections. He is associated in memory with the old home, the cool sparkling brook, the ferns and the wild flowers, the singing birds and the shady nook, childhood's friends, and the dear old home folks. Ah! me, those were happy days indeed. In memory we live them all over again, by the uncertain light we can see a youth appear and softly close the door behind him. A faint glow lights up the east, he lingers a moment on the stoop. The glory of the morning possesses his soul. The cool, moist air comes up from the meadows, rich with the perfumes of the new mown hay and lingers caressingly on

the brow flushed by the hasty preparations. Passing down through the orchard, his heart is thrilled by the morning hymn of the warbler, unconsciously the pure melody of the boy's heart bursts forth in answering strains. The robin, in the cherry tree, ceases his labors for a brief moment, to listen, his archly poised head disclosing a breast ruby red, as though dyed with the stolen fruit. A sharp tramp over the hills to the brook, then—the stealthy approach, the light cast, the quick rush, the long struggle, the light rod bends like a reed, every nerve quivers. It is over, he lies in the wet grass, gasping for breath, his heaving sides, richly colored and gaily marked glisten in the morning light. The fiercely gleaming eye tells of a spirit unsubdued, captive but unconquered. The wild joy of the conquest passes away leaving only a feeling of admiration. Isn't he a noble fellow! The creator *could* have made a better fish, but—in His wisdom—He did not.

MAINE AND THE SPORTSMAN.

(Accompanied by Lantern Slides).

BY A. H. DINSMORE.

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

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

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

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

from poachers, and to report to the commissioners the number of people guided and the amount of fish taken and game killed.

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

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

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

Brook trout are found throughout the lake regions and here reach their maximum size. Lake trout, or togue, as they are

called in Maine, are taken in many of the lakes, but are generally little esteemed by either resident or non-resident sportsmen. The food quality of this fish varies greatly in different localities.

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

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

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

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

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

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

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

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

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

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

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

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

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Oberfelder, R. S., Sidney, Neb.
O'Brien, W. J., Dunbar, Wis.
O'Connor, E. M., Savannah, Ga.
O'Hage, Dr. Justus, St. Paul, Minn.
O'Malley, Henry, Baker, Washington.
Orr, W. J., Bay Port, Mich.
Osborn, Wm., Duluth, Minn.

Page, P. W., West Summit, N. J.
Parker, Dr. J. C., Grand Rapids, Mich.
Parker, W. H., Lac la Peche, Quebec, Canada.
Peabody, George F., Appleton, Wis.
Peck, Hon. Stephen, Warren, R. I.
Pike, Robert G., Middletown, Conn.
Powell, W. L., Harrisburg, Pa.
Powers, J. A., Lansingburg, N. Y.
Powers, John W., Big Rapids, Mich.
Prather, J. Hub, Lexington, Ky.
Preston, Hon. John L., Port Huron, Mich.
Preston, Dr. Henry G., 98 Lafayette Square, Brooklyn, N. Y.
Proctor, Hon. Redfield, Proctor, Vt.

Rathbone, Wm. F., D. & H. R. R., Albany, N. Y.
Rathbun, Richard, Smithsonian Institution, Washington, D. C.
Ravenel, W. DeC., United States Fish Commission, Washington, D. C.
Reighard, Prof. Jacob E., University of Michigan, Ann Arbor, Mich.
Richards, G. H., Boston, Mass.
Roberts, A. D., Woonsocket, R. I.
Robinson, W. E., Mackinaw City, Mich.

Robinson, A. H., St. Johnsbury, Vt.
Rodgers, Frank A., Grand Rapids, Mich.
Rogers, J. M., Chicago, Ill.
Root, Henry T., Providence, R. I.
Rosenberg, Albert, Kalamazoo, Mich.
Ruge, John G., Apalachicola, Fla.
Russel, Henry, Detroit, Mich.

Sampson, E. R., care of New York Aquarium, Battery Park, New York City.
Sanborn, F. G., 438 Montgomery St., San Francisco, Cal.
Scarborough, L. A., Columbus, Ga.
Schley, Dr. F. V., Columbus, Ga.
Schute, John A., Havana, Ill.
Schweikart, Walter, Detroit, Mich.
Seagle, Geo. A., Wytheville, Va.
Self, E. M., Bullochville, Ga.
Sellers, M. G., Philadelphia, Pa.
Sexton, Cramer, Murfreesboro, Tenn.
Sherwin, H. A., 100 Canal St., Cleveland, O.
Singleton, James H., Woonsocket, R. I.
Smith, Henry D., Appleton, Wis.
Smith, Jay, care of J. W. Marston & Co., Lewis Wharf, Boston, Mass.
Smith, L. H., Algona, Iowa.
Smith, Dr. Hugh M., United States Fish Commission, Washington, D. C.
Smith, Capt. J. A., Woods Hole, Mass.
Snyder, Dr. F. B., Ashtabula, Ohio.
Solman, Alden, South Norwalk, Conn.
Southwick, J. M. K., Newport, R. I.
Spencer, L. B., Supt. Aquarium, 37 W. 128th St., New York City.
Spensley, Calvert, Mineral Point, Wis.
Springer, F. H., Columbus, Ga.
Starbuck, Alexander, Cincinnati, O.
Starr, W. J., Eau Claire, Wis.
Stelle, G. F., Chicago, Ill.
Sterling, J. E., Crisfield, Md.

Stewart, Chas. E., Westerly, R. I.
Stewart, A. T., Northville, Mich.
Stone, Livingston, Cape Vincent, N. Y.
Stranahan, J. J., Bullochville, Ga.
Stranahan, F. A., Cleveland, O.
Stranahan, F. F., Cleveland, O.
Stranahan, H. B., Cleveland, O.
Suthers, Frank, Madison, Wis.
Sykes, Arthur, Madison, Wis.
Sykes, Henry, Bayfield, Wis.

Tawes, J. C., Crisfield, Md.
Taylor, A. R., 318 Main St., Memphis, Tenn.
Thayer, W. W., 234 Joseph Campau Ave., Detroit, Mich.
Thompson, Carl G., 78 Henry St., Huntington, Ind.
Thompson, W. T., Nashua, N. H.
Thompson, W. P., 112 Bread St., Philadelphia, Pa.
Tinker, E. F., St. Johnsbury, Vt.
Titcomb, John W., St. Johnsbury, Vt.
Townsend, Chas. H., United States Fish Commission, Washington, D. C.
Trumpour, D. A., Bay City, Mich.
Tubbs, Frank A., Neosho, Mo.
Tucker, Edmund St. George, Bedford Row, Halifax, N. S.
Tulian, Eugene A., Leadville, Colo.
Turner, J. C., Columbus, Ga.

Van Cleef, J. S., Poughkeepsie, N. Y.
Vincent, W. S., Leadville, Colo.
Vogelsang, Alexander T., Mills Building, San Francisco, Cal.

Walker, Bryant, Detroit, Mich.
Wallett, W. H., Put-in-Bay, O.
Walters, C. H., Cold Spring Harbor, N. Y.
Ward, Prof. H. B., Lincoln, Neb.
Webb, W. Seward, Forty-fourth St. and Vanderbilt Ave., New York.
Wentworth, Edwin, United States Fish Commission, Nashua, N. H.
Wentworth, Nathaniel, Hudson Centre, N. H.

Weed, W. R., Potsdam, N. Y.
Wetherbee, W. C., Port Henry, N. Y.
Wheeler, Chas. Stetson, Hobart Building, San Francisco, Cal.
White, R. Tyson, 320 Bridge St., Brooklyn, N. Y.
Wilbur, H. O., 235 Third St., Philadelphia, Pa.
Wilbur, P. H., Little Compton, R. I.
Willard, Chas. W., Westerly, R. I.
Willetts, J. C., 40 Wall St., New York.
Williams, J. A., St. Johnsbury, Vt.
Wilson, C. H., Glens Falls, N. Y.
Wilson, S. H., Cleveland, O.
Winn, Dennis, Nashua, N. H.
Wires, S. P., Lester Park, Duluth, Minn.
Wisner, J. Nelson, Jr., United States Fish Commission, Washington, D. C.
Wood, C. C., Plymouth, Mass.
Woodruff, C. B., Columbus, Ga.

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

HONORARY.

Borodine, Nicholas, Delegate of the Russian Association of Pisciculture and Fisheries, Uralsk, Russia.
Fish Protective Association of Eastern Pennsylvania, 1020 Arch St., Philadelphia, Pa.
Lake St. Clair Shooting and Fishing Club, Detroit, Mich.
New York Association for the Protection of Fish and Game, New York City.
Peck, Hon. Geo. W., Milwaukee, Wis.
South Side Sportsmen's Club, Oakdale, L. I., N. Y.
Sweeny, Dr. R. O., Lester Park, Duluth, Minn.
The President of the United States.
The Governors of the Several States.
Woodmont Rod and Gun Club, Washington, D. C.

CORRESPONDING.

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

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

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

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

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

Feddersen, Arthur, Copenhagen, Denmark.

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

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

Jaffe, S., Osnabruck, Germany.

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

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

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

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

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

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

Olsen, O. T., Grimsby, England.

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

Senior, William, London, England.

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

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

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

Trybom, Dr. Filip, Stockholm, Sweden.

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

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

RECAPITULATION.

Active	291
Honorary	54
Corresponding	25
Total membership	370

CONSTITUTION.

(As amended to date).

ARTICLE I.

NAME AND OBJECTS.

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

ARTICLE II.

MEMBERS.

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

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

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding

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

ARTICLE IV.

MEETINGS.

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

ARTICLE V.

CHANGING THE CONSTITUTION.

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

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-first Annual Meeting

AUGUST 5, 6 AND 7, 1902.

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

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

Officers for 1902-1903.

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

EXECUTIVE COMMITTEE.

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

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

E. A. BIRGE, Madison, Wis.

J. J. STRANAHAN, Bullochville, Ga.

DWIGHT LYDELL, Mill Creek, Mich.

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

INDEX.

PART I.

BUSINESS SESSIONS.

Transactions of the American Fisheries Society.

Tuesday, August 5, 1902.

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

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

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

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

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

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

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

Corresponding Membership:

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

Mr. F. B. Dickerson took the chair.

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

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

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

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

Dear Sir:—

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

SAM. F. FULLERTON,
Executive Agent.

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

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

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

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

We have everything to cheer us on in this work. It is less than half a century since the feasibility of the idea of increasing the productivity of the waters was brought to the notice of men; and the result that has been accomplished in that half century is

something marvelous, and the progress of the work and the results being achieved by the states and by the United States and by the enterprising gentlemen who are entering upon this work to produce fish for the market, are something to give us especial gratification.

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

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

I am requested by the United States Fish Commission to give you the grand totals of their work for the year. You recollect their report last year showed an extraordinary growth and increase in their output. So far as I have been able to examine the state reports, everywhere there is evidence of increased success, larger output, broader and more generous distribution; and

the figures which will appear in the United States report soon to be published for the fiscal year ending June 30th, 1902, will show a very gratifying increase in the beneficient results of the work of the United States Fish Commission, in every line of productivity; and I am pleased to notice that whenever we write to congressmen, in behalf of the commission, to aid us, or to be helpful along the lines of supporting the United States Fish Commission, and indirectly the other commissions, they invariably reply that they are heart and soul with the fish commission and wish to render it every aid possible. We have a grand total here of a billion and a half distribution of fish during the last year, while for the previous year it was a little over a billion. This increase is shown in nearly all the lines of production, a very gratifying result, and one that gives us all encouragement to go on.

The report furnished me is as follows:

SUMMARY OF DISTRIBUTION,

1902.

TOTAL	EGGS	Fry and Fingerling	Adult and Yearling	TOTAL
Shad	.....	104,986,000	2,000,000	106,986,000
Quinnat Salmon	19,346,410	29,337,308	.....	48,683,718
Atlantic Salmon	300,000	56,765	282,000	638,765
Landlocked Salmon	200,000	523,655	98,565	822,220
Silver Salmon	.....	424,530	.....	424,536
Blueback Salmon	.....	3,371,000	.....	3,371,000
Steelhead Trout	68,000	389,196	77,686	534,882
Loch Leven Trout	.....	91,760	5,000	96,760
Rainbow Trout	397,790	784,835	492,496	1,675,121
Blackspotted Trout	280,000	100,000	1,488,500	1,868,500
Brook Trout	920,000	5,222,422	437,340	6,579,762
Lake Trout	5,235,000	22,022,478	3,012	27,260,490
Scotch Sea Trout	10,000	7,694	6,837	24,531
Golden Trout	.....	69,950	.....	69,950
Grayling	655,000	1,130,333	17,925	1,803,258
Whitefish	111,260,000	483,230,000	.....	594,490,000
Pike Perch	60,000,000	177,099,000	.....	237,099,000
Catfish	.....	.....	95,970	95,970
Pike	.....	.....	575	575
Pickerel	.....	.....	805	805
Ring Perch	.....	.....	1,700	1,700
Buffalo	.....	.....	200,000	200,000
Black Bass	.....	.....	262,157	262,157
Crappie	.....	.....	735,120	735,120
Rock Bass	.....	.....	37,170	37,170
Strawberry Bass	.....	.....	3,351	3,351
Warmouth Bass	.....	.....	100	100
Calico Bass	.....	.....	200	200
Sunfish	.....	.....	606,040	606,040
Bream	.....	.....	17,699	17,699
Cod	.....	212,001,000	.....	212,001,000
Flatfish	.....	168,133,000	.....	168,133,000
Lobster	.....	81,020,000	.....	81,020,000
Totals and Grand Total	198,672,200	1,290,000,926	6,870,248	1,495,543,374

I should be very glad if we had a brief presentment to show what had been accomplished by the various states. I can only

say in general terms that they are all making good gains and advances. With these somewhat hasty remarks, gentlemen, I will not detain you longer from the business which we are met here to transact.

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

Motion seconded and carried.

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

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

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

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

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

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

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

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

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

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

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

Mr. Dickerson: Yes, but it did not pass both houses on account of lack of attention. My suggestion is that the president appoint a committee to watch that thing and push it at all stages

of the game at the next congress. If we had done that before we would have passed it at this last congress.

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

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

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

Motion seconded.

Mr. George F. Peabody, of Appleton, Wis.: I think Mr. Dickerson's idea is a very excellent one, but still the initiative

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

Mr. Dickerson: They have no water in Ohio.

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

It seems to me that the scope of this society is to go on as it is doing in original investigation and in discussion of methods of propagating fish and all that sort of thing. It is throwing a brilliant light on the subject of fish culture, each year more widespread. This season, as secretary of the society, I have had applications from foreign countries and from all over the United States, and from men whom you would think were not interested especially in this work, for the printed transactions of the society, and that indicates that the interest is growing and is widespread. I think the thing to do is to get at the state fish com-

missions, get at the governors and have them appoint commissions like the fish commissions of Wisconsin and Michigan, Rhode Island and other states which are enthusiastic and interested and will promote education as suggested in the resolution.

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

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

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

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

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

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

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

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

Motion seconded and unanimously carried.

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

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

Motion seconded and carried.

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

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

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

Motion seconded and unanimously carried.

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

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

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

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

The treasurer's report was then presented as follows:

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

To the American Fisheries Society:

Gentlemen:—

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

RECEIPTS.

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

EXPENDITURES.

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

Depository of funds, Manufacturers Trust Company, Providence, R. I.

C. W. WILLARD,
Treasurer.

Mr. Willard:—I should like to have the report referred to an auditing committee.

The President: I will appoint such committee at the request of the treasurer.

On hearing the report of our good treasurer and noticing that he accounts for interest on deposit, reminds me that it was told historically, I believe, that the great William Pitt when he was made paymaster of the forces, the general understanding being that he was to have the interest on deposits as part of the perquisites of his office, with stern honesty accounted for every cent of the interest as well as principal; and a great many people of England thought that he was foolish to do it. The great Edmund Burke, also made paymaster of the forces for the purpose of enriching his purse, was so strictly honest that he ac-

counted for the interest on the deposits; and I am glad to find that our good treasurer, with the same sense of fidelity and loyalty to our fund, has accounted for the interest, and deserves especial commendation for his frugality and financial wisdom in investing our funds so that they yield an income.

Mr. Peabody: A large number of letters of regret have been presented, also excuses for not furnishing papers, and I suppose it is unnecessary to read them all, but there is one from Mr. E. W. Blatchford to which I should like to refer. A great many of you remember him at Wood's Hole. He was very much interested in the matter of a monument to Prof. Baird; and the latter part of his letter is of interest as pertaining to that subject. He says:

"The 'Baird Memorial Committee' are engaged in preparation for the dedication of the admirable granite boulder and tablet in Prof. George Baird's memory—the large and thoughtful work connected with which has been done by our honored chairman—Dr. Smith."

Mr. Gunckel: I may be fishing in water where I cannot land the fish, but at least I can cut bait. I would respectfully suggest a change in the constitution and by-laws as follows: Make present Article 5, Article 6, and then add Article 5 which shall read as follows:

"Order of business shall be as follows:"

(You all notice the trouble that we have in the order of business).

"First: Call to order by the president.

"Second: Roll call of members.

"Third: Application and action on new members.

"Fourth: Reports of officers, president, secretary and standing committees.

"Fifth: Appointing committee of five to nominate officers for ensuing year.

"Sixth: Appointing committee of three on time and place for next meeting.

"Seventh: Appointing auditing committee of three.

"Eighth: Reading of papers and discussions on same.

"N. B.—Preference to reading papers shall be given to members present, and in order of notices received by the secretary.

(I did not prepare a paper this time, because I thought as you met in Ohio, it would be a matter of respect to the other states that Ohio should give way to the distinguished gentlemen from abroad. A man who comes 500 miles to attend our meetings and has given notice that he is going to read his paper, should be entitled to first attention and a full house).

"Ninth: Payment of annual dues."

I respectfully submit this for your consideration, and only suggest it because I think it may be something that will lead us to firmer ground.

Mr. Peabody: I move that this matter be referred to a committee of three.

Motion seconded and carried.

Mr. Clark: I move that the secretary be instructed, if necessary, to mail a copy of the present printed report to all new members.

Motion seconded and unanimously carried.

Secretary Peabody: I have sent them to all of the members that we have received during the year, and there are enough to go around now.

Mr. Titcomb: I would say in connection with this that a resolution was passed at the meeting at Wood's Hole, providing for the sale of back copies of the transactions, so far as available, to those wishing to complete their files. I simply call attention to the matter.

Dr. Reighard: Are there complete sets?

Secretary Peabody: No, there are no complete sets.

Mr. Frank N. Clark, of Michigan, then presented a paper on the subject, "A Successful Year in the Artificial Propagation of the Whitefish."

The president appointed as committee on nominations and selection of place of meeting: F. N. Clark, of the United States Fish Commission, Dwight Lydell, of Michigan, J. J. Hogan, of Wisconsin, G. T. Mathewson, of Connecticut, and H. B. Ward, of Nebraska.

As committee to urge upon congress the importance of establishing a biological station on the great lakes, F. B. Dickerson,

of Michigan, Jacob Reighard, of Michigan, E. A. Birge, of Wisconsin, J. E. Gunckel, of Ohio, R. T. White, of New York.

Prof. Reighard: Arrangements have been made for the reading of my paper accompanied with stereopticon views, in a large assembly room of the hotel, at 8:30 o'clock tonight.

While I am on my feet I wish to present to the society Mr. Dickerson's excuses for leaving, but pressing private business required him to return home this afternoon.

Adjourned to 8:30 p. m., same day and place.

EVENING SESSION, 8:30 O'CLOCK.

Meeting called to order by the president.

The President: You all probably know that our appointment this evening to hear the lecture of Dr. Reighard failed because of lack of electric current to operate the lamp to be used, and so we have concluded to spend the evening in the regular business of the society, taking up the reading of papers and receiving reports of committees.

The chairman of the program committee then presented the following report: The committee on program were unanimously decided that the day's session should begin at 9:30 a. m. and last until 12, and begin in the afternoon at 2:30 and last until 5; that the papers of those who were present should be read in preference to the papers of those who are not here to read them personally; and the idea was that the bass papers should be grouped and all read at one session. The plan was to have the bass papers in the morning, and talking with the committees separately about this meeting tonight, it was thought that if the members present desire to continue, the trout papers might best be taken up tonight, one by Mr. Seagle and one by Mr. Marsh. Tomorrow afternoon after the session, if the members desired, there could be another trip on the Shearwater, which in fact is at the disposal of the members at any time.

Report of committee unanimously adopted and committee discharged.

Mr. M. C. Marsh then read a paper on the subject of "The Brook Trout Disease and Cement Ponds."

Mr. George A. Seagle, of Virginia, then read a paper on the subject, "Some Remarks on the Rainbow Trout, the Time for Planting, etc."

Mr. J. J. Stranahan, of Georgia, then presented a paper on the subject, "Fish Culture on the Farm."

(Read by Mr. Titcomb).

Adjourned to 9:30 a. m., Wednesday, August 6th, 1902, same place.

Wednesday, August 6, 1902.

MORNING SESSION, 9:30 O'CLOCK.

Convention called to order by the president.

The president appointed as a committee on proposed amendment to the constitution, Mr. Gunckel, of Ohio, Mr. Pike, of Connecticut and Mr. Stranahan, of Georgia.

Dr. Bean: I would like to extend an invitation to the members of the American Fisheries Society to consider the advisability of holding the meeting in 1904, at St. Louis, at the time of the exposition. I am well aware that the last meeting of the American Fisheries Society held in Chicago in 1893, was not in every respect as satisfactory as it might have been, for reasons with which doubtless many of you are entirely familiar. There was strife at that time; there is none now. In the year 1904 the United States government will, I have no doubt, make the finest display both in fisheries and fish culture which it has ever made, and there is a perfect understanding between the authorities of the exposition and the authorities of the United States Fish Commission, so that both will work harmoniously, intelligently and enthusiastically, with the object of bringing together not only interesting displays, but discussions of fish culture and fishery subjects. I suppose this meeting would be held at a time of the year which would be agreed upon by the society.

St. Louis has the reputation of being a very hot city in summer. I have spent the present summer there, and it is the first summer I have spent in any city in twenty-five years, and I have suffered far less than I have in Washington at the same time of

the year. It is a cool year, I know, but 1904 may be another cool year. In ordinary years the temperature of St. Louis is much more endurable than that of a great many of the eastern cities. I have lived in New York for a good many years and am a resident of New York now, and when I say that St. Louis has treated me more kindly in the matter of comfort than New York City, you may be surprised, but it is nevertheless true.

In St. Louis, as I said, the government will have a very large display of live fish and of fishery appliances, and in addition to that the foreign governments will come in and show what they can do in the way of fish culture and oyster culture. While, of course, in some respects we have very little to learn from the foreigners, yet in other respects, especially in oyster culture and in the handling of lobsters and other crustaceans, we have a great deal to learn from the Europeans—and they will be there. Their space is already engaged, and we shall have their representative men in fish culture as well as in fishery.

Now, St. Louis is one of the most important places in the west, not only as a fish market, but as a city in which fishing interests are enthusiastically considered. I believe that I have never found a city of its size which contained so many intelligent fishermen. It is a singular thing that the state does not reflect the sentiment of St. Louis. I suppose it is because the state officers, the commission, may be politicians—that I don't know. I am not interested at all in politics, but I have found that whenever a commission does run into politics there is very little work done except that which will serve the politician's purpose, and I can account for it only in that way. Aside from that, St. Louis is really a remarkable place as a fish center, that is to say, a market for fresh and preserved fish, as a place from which anglers go out to catch fish and study fish. Therefore, gentlemen, I hope that you will look over this matter favorably and decide next year to hold your meeting in St. Louis. You will be very welcome and the exposition authorities will do everything in their power to make you comfortable and happy.

The secretary then presented the following letters:

St. Louis, Mo., July 24th, 1902.

Mr. J. E. Gunckel, Corresponding Secretary,
The American Fisheries Society,
Toledo, O.

Dear Mr. Gunckel:—

I have seen the announcement of the meeting of the American Fisheries Society to be held at Put-in-Bay, August 5th to 7th. I wish I could be with you, and possibly I may be there. I am writing you now to ask your co-operation in securing a meeting of the society at the Exposition in St. Louis in 1904. Of course it is a little early to pass a resolution on this subject, but not too early to agree informally, at least, to such a course. You know that meetings of fishery societies at international expositions have always been extremely interesting. The Exposition authorities will welcome you, and you will be provided with a suitable place in which to hold sessions.

Will your state do anything about a fish exhibit at St. Louis? I am sending you, herewith enclosed, some copies of the first circular of the Fish and Game Department. I also have charge of the Forestry Department as Acting Chief. Kindly write to me as soon as convenient and let me have your assurance of sympathy and co-operation.

Very truly yours,
TARLETON H. BEAN.

THE FISHING GAZETTE.

G. E. Jennings, Publisher and Proprietor.

203 Broadway,
New York, August 4th, 1902.

Mr. George F. Peabody,
Secretary of the American Fisheries Society,
Hotel Victory, Put-in-Bay, Ohio.

My Dear Mr. Peabody:—

I regret exceedingly that I cannot be with you, for owing to sickness, etc., I find it necessary to remain in New York during the month of August. I am, of course, greatly disappointed, for I had anticipated a pleasant outing with you all on Lake Erie. However, I shall have to postpone my meeting with you until next year, when I hope the meeting will be held in an eastern city.

I returned from Halifax on Friday and stopped at Boston on my way and called upon Capt. J. W. Collins, Chairman of the Commissioners of Fish and Game of Massachusetts, who was at one time a member of the society. I suggested that it would be a graceful act to invite the society to hold their next meeting in Boston, but Captain Collins very modestly said that he was not in a position to do so, but I feel sure that if Boston should be chosen the members from that city, particularly John R. Neal, who is one of the most prominent fish merchants in the United States, and Mr. Jay Smith and I think also Captain J. W. Collins, would be only too willing to

make it pleasant for the members. I feel quite sure that if the meeting should be held in that city, I could get a number of prominent business men interested in the society and enlarge the list by a number of new names.

This, of course, is all subject to the committee on location—merely a suggestion. Boston is well located for an outing for the western members, who are fond of the sea and its products, and convenient to a number of well known seaside resorts, and I think it would be well to consider having the meeting there next year.

Trusting the present meeting will be a big success and wishing to be kindly remembered to all, I remain,

Yours truly,
G. E. JENNINGS.

Mr. Titcomb: I do not think it is wise to begin the discussion of papers on black bass until more members are present, and I do not like to appear on the floor too often, but as a little tribute to the scientists of the commission I want to read a little squib which I see comes from the London Chronicle:

THE LOBSTER HATCHERY.

Nature grim, in remorseless mood,
  Undoes the work that she has done,
And out of every lobster brood
  Slays ninety-nine and keeps but one.

Art stretches o'er the horrid scene
  Her skillful and remedial sway—
And when I speak of "Art" I mean
  The Fish Commission, U. S. A.

It takes the tender lobsterlet,
  And gives him food and kind advice,
Changes his boots if they are wet,
  Brushes his hair and makes him nice.

And lo, this baby of the sea
  In gratitude begins to thrive;
Where one per cent it used to be,
  Fifty, all fat, remain alive.

O noble work, heroic, grand,
  That saves in scientific ways
Those little lisping lobsters, and
  Keeps them for me and mayonnaise.

Mr. Gunckel: The committee on amendment of constitution and by-laws is ready to report.

The President: We will hear their report.

The report was then read by the secretary as follows:

AMENDMENT TO CONSTITUTION AND BY-LAWS.

New Article: Order of Business.

Instead of present Article No. V.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by the president.
2. Roll call of members.
3. Application of new members.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the president.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—In the reading of the papers preference shall be given to members present and in the order of notices received by the secretary).

7. Adjournment.

Dr. Birge: I move the adoption of the committee's report.

Motion seconded.

Dr. Birge: I should like to ask a question. This is a substitute for Article V?

Mr. Gunckel: Article V becomes Article VI. I thought that the secretary would understand that. Article V is an amendment to the constitution.

Dr. Birge: May I ask in what way the constitution can be amended?

Mr. Gunckel: At any time by a vote of two-thirds of those present, provided fifteen are present.

Dr. Birge: My own feeling is that unless it is very easy to get away from it, it is not advisable to tie ourselves up to an order of business from which we cannot depart pretty readily. I notice, for instance, one thing in this proposed amendment which I feel sure the society will want to change quite frequently, and that is, that the papers are to be read in the order in which notification is received by the secretary. Certainly if we have a group of papers on a given subject, as we had last night on the trout, and are expecting to have today on the black bass, I suppose it would be frequently, at least, the wish of the society that the papers connected in subject should be read together, rather than scattered around and sandwiched in with papers that have no relation to them.

Mr. Titcomb: I concur with Prof. Birge on that part of this amendment. It seems to me that the order of the reading of the paper should be decided by either a committee or the officers who have charge of the meeting, and if this rule is adhered to we would not have our papers grouped in the order they ought to come. For illustration, today, by your committee on program, it was suggested that we take all of the day's papers at one session, and very frequently a man comes a long distance and is interested in bass, or is interested in trout. Now, he would like to hear everything on that one subject during one session; he may have to go away. I think further while talking on this subject, though it may not be entirely about that resolution, that we ought to have a committee to whom all papers should be submitted, and let them decide whether those papers are all to be read. We may have some paper that we do not want published by the American Fisheries Society. Some crank may read a paper which does not do the society credit. We might get some stuff into our pamphlets that would not do us credit when sent broadcast through the world as our pamphlets are; and a committee could look them over and be a sort of a censor body perhaps. I object to that clause. I think if that note was simply omitted, then we can suspend rules any time to carry out Prof. Birge's idea, and we would not be tied up in that particular part of it. I think we ought to have an order of business.

The President: The sixth order of business is reading of papers and discussion of same, and to this is appended a note as follows: "In the reading of papers preference shall be given to members present and in the order of notices received by the secretary." The suggestion is that the note be stricken out.

Mr. Gunckel: If you will allow me, of course it is generally known that if I can slip in a paper occassionally it doesn't amount to anything—I admit that—but being in the position that I am and not of a scientific nature, except what I can glean from these meetings, I would say that this suggestion does not come originally from me, but from a great many members present who read papers nearly every time. You have twice, I think, carried motions, to the effect that gentlemen who are present shall have the preference of reading their papers over those who are absent; and this is the first time since I have attended any of the meetings where you have divided papers off into groups. That, of course, would naturally change the preference that I have inserted there, but certainly a man who has come 400 or 500 miles and whose time is limited ought to have the preference in reading his paper over one who is not present, but who has sent his paper in, thus perhaps delaying the paper of a man who is present until too late to read or discuss it. It is unfair. That is the argument, and I strongly think that that note of preference there should be given to the writers of papers who are present. You can divide the papers up into groups or in any way you wish, but the men who are present certainly should have the preference.

Then again, if I get up at 5 o'clock in the mornings and study for a whole month and prepare a scientific article and I come here to read it and want to discuss the subject, I am certainly entitled to the presence of a majority of the members. Some of you members have spent a lifetime in propagating fish and learning the secrets of their movements and everything, and it is not fair to a man who comes a great distance to be put back to the last in favor of some one who has sent in his paper late.

Dr. Birge: I think you misunderstand my point and that of Mr. Titcomb. The thing I objected to was in regard to the papers being read in the order of notices received by the secretary. I am ready to agree that the members present should have

the preference in the matter of reading papers; that is the ordinary custom in societies; but I should strike out that last part. The fact that I give notice of preparation of a paper three months ahead ought not to put my paper on the first session as against the man who sends in his notice one month ahead.

Mr. Gunckel: The man that gets up in the morning and sends in his article first pleases the secretary. The man that is late, sneaks in and hands an article to the secretary and says he has prepared it since he has been there, should not be allowed to read his paper first. I say the man who got here early should be recognized first.

Mr. Titcomb: I think, as Dr. Birge says, we are all agreed that the people who are here should have the opportunity to read their papers in preference to those presented later, but I think we ought to have some system about grouping our papers, and if we adopt the note as it now reads, we are going to get, perhaps, a paper on trout culture the first part of the session and then take up a paper on trout culture again the last part of the meeting. I think all kindred subjects should be taken up together, just as we take up the bass question this morning.

Mr. Gunckel: Then strike out the words "in the order of notices received by the secretary."

Dr. Reighard: I move to amend the report by omitting that clause which refers to the papers being read in the order of notices received by the secretary.

Motion seconded.

The President: That will leave liberty of adjustment and grouping of papers at the meeting.

Unanimously carried.

The President: The amendment to the constitution, as amended, by adding Article Five and changing the present Article Five so as to read Article Six, is now before you, as amended.

Mr. Clark: The committee are ready to report on officers and place of meeting.

The President: We will receive the report.

Prof. Ward: I should like to move that it be the rule of this society that the officers shall be empowered to group and arrange the papers for the session, constituting them practically

a committee for that purpose, and enabling them to do it a little in advance of the time of the meeting. I propose that as a standing rule.

Motion seconded.

Mr. Titcomb: Do you wish to include all of the executive committee? I think if it is left to the president and secretary you will have the thing done more quickly than if you wait for all the officers to get together.

Mr. Ward: I will accept the suggestion, making it a committee of three, the president and the two secretaries.

The President: Will you state the motion again?

Prof. Ward: That the president and the two secretaries be empowered to arrange and group the papers for the programme of the meetings of the society.

Mr. Gunckel: We have had motions similar to that and we always forget them. Now, why can't you make that part of Article Five of our constitution and by-laws, right after the article we have discussed here, and then it will always appear in our report. We have no back reports here. There are a lot of motions which we have forgotten all about. There is one made in New York a few years ago, and you have forgotten all about that.

Prof. Ward: I will gladly do that if it can be adopted constitutionally. Now, I should be glad to accept the suggestion and make it Section 2 of the present article.

Mr. Gunckel: I would suggest that under Rule 6 this proposed amendment shall be noted as Section "b."

Dr. Birge: I would suggest that the words, "and group" be omitted. The power to arrange is sufficient.

Prof. Ward: I will accept the suggestion.

The proposed amendment to the constitution is that the president and the two secretaries be empowered to arrange the papers of the meetings of the society, and that that be added to Article 5 as Clause "b" of the constitution just amended.

Seconded and unanimously carried.

The amendment to the constitution as finally adopted is as follows:

AMENDMENT TO CONSTITUTION AND BY-LAWS.

New Article: Order of Business.
(Instead of present Article V.)

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of Officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—a. In the reading of papers preference shall be given to members present.
b. The President and the two secretaries are empowered to arrange the papers of the meetings of the society).

7. Miscellaneous business.
8. Adjournment.

Mr. Clark: Without taking up too much time I will state that the committee on time and place have had under consideration the invitations from different points, very cordial ones from Niagara Falls, Buffalo, Wood's Hole and Mill Creek, Michigan. Those presenting the names of these different cities (especially Mill Creek) have invited the society very cordially. Mr. Tuttle presented the Niagara Falls matter, and they are all good places —no question about it—but the committee have decided to make the following report:

After carefully considering the invitations from the several

cities, we respectfully suggest that the next annual meeting be held at Wood's Hole, Massachusetts, on Tuesday, Wednesday and Thursday of the fourth week of July, 1903, namely the 23rd, 24th and 25th of July, and that the meeting be called to order at 2 p. m. on Tuesday. It is further suggested that the place and time be printed on the letter heads usually furnished by this society.

They also wish to report as their suggestions for officers for the year:

President—George M. Bowers, Washington, D. C.

Vice President—Henry B. Ward, Lincoln, Neb.

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

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

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

Mr. Peabody: I would like to say that it will be impossible for me to act next year. As I am planning now, I may be out of the country; and further, I think it was rather understood that we were to take turns at this thing, and it is quite a responsibility and quite a duty. If my memory serves me right, I think it was understood that one year's service entitles one to be retired from that position, and I will ask you to substitute some one else for that office.

Mr. Gunckel: Naturally the corresponding secretary follows suit. Of course the corresponding secretary's duties are not very laborious—a little correspondence from the east and west—but I think as that is more of an honorary position, that you ought to change and have some other person. It is not very important to me, because there is little to do, but I think you ought to follow the rule and change. Of course the committee thought it a matter of delicacy and did not like to put me out in the cold world, but I will be very glad indeed if the committee will withdraw my name and put some other person there.

Mr. Titcomb: I rise to a point of order. There is nothing before the meeting.

The President: The rule of the American Fisheries Society is, no flunking. The point of order is sustained.

Mr. Clark: I move the adoption of the report of the committee.

Motion seconded.

Mr. Clark: Mr. Peabody makes a statement that I hardly think he is warranted in making. I do not remember that at the meeting at Milwaukee anything was said about the secretary's serving but one year. I think if he goes out serving as secretary of this society only one year, that it will go to the world that this society did not think much of his work, and I for one wish to say emphatically that Mr. Peabody has made one of our best secretaries, and we have had good secretaries before him; but I really think that Mr. Peabody should reconsider what he has said. If Mr. Peabody is going to be gone the whole year, why his excuse might avail, but I hardly think that Mr. Peabody will be gone out of the United States for a whole year; I think he is too much of an American for that. He may go away to Europe for a month or two, but he will come back with renewed vigor, and can serve this society better than he has in the past, if that be possible; and I therefore hope the society will not consider his remarks.

(Voices: Question! Question!)

The report of the committee was unanimously adopted, with the exception of the vote of Mr. Gunckel, which was cast in the negative.

The President: The noes are out of order.

Mr. Gunckel: I wish to make one statement to the members. I would like to have them remember that the corresponding secretary has nothing to do with sending out the books. A great many letters come to me that should go to the recording secretary. Now, all questions on scientific subjects go to the recording secretary, all questions and problems of angling go to the recording secretary. To get truthful stories, go to the recording secretary, but if you want to learn how to lie, that matter is within the province of the corresponding secretary, and all information will be cheerfully furnished by him. (Great applause and laughter).

The President: He takes charge of the Department of the Imagination.

Mr. Gunckel: Yes, sir, I take charge of that.

Mr. Peabody: I have a letter here that one of the gentlemen from Ohio wishes me to read, as it is perhaps a defense of and

an apology for the state of Ohio having no representative of and from their commission. I presume that is his purpose. There are on this letter head the names of the president and four members and two officers, but none of them is present.

STATE OF OHIO.
FISH AND GAME COMMISSION.

J. L. Rodgers, President, Columbus.

Paul North, Cleveland. Thomas S. Paxton, Cincinnati. Dr. D. W. Greene, Dayton. Edwin M. Kennedy, McConnelsville. J. C. Porterfield, Chief Warden, Columbus. George C. Blankner, Secretary, Columbus.

Columbus, Ohio, August 4th, 1902.

S. W. Downing, Supt.,
U. S. Fish Hatchery,
Put-in-Bay, Ohio.

Dear Sir:—

I had fully intended being present at the meeting of the American Fisheries Association at Put-in-Bay this week, but I find now that I am called away by an important matter and that it will be absolutely impossible for me to get back in time to attend. Please accept my thanks for your kind invitation and my sincere regrets that I cannot be present.

Wishing you a most successful meeting, I am,

Yours very truly,
J. L. RODGERS,
President.

Mr. Gunckel: That, coming from the Ohio Fish Commission, shows the first recognition the American Fisheries Society has had since 1890 from the commission, and I would make a motion that the secretary, or corresponding secretary, write officially to them, thanking them for recognizing the association, and insisting on the state of Ohio taking a greater interest in the association than it has.

Mr. Downing : I would like to correct the statement in regard to the first recognition; I think the first recognition was yesterday when I put in six dollars for the members from the Ohio Fish Commission.

The President: I think it would be well for the society to recognize that we have been hospitably entertained on the soil of Ohio, and let it go at that, and not make any record of the fact that we missed them.

The president here appointed as a committee to audit the

treasurer's accounts Mr. Lane, of Massachusetts, Mr. Geer, of Connecticut, and Mr. Downing, of Ohio.

Mr. Titcomb: I wish to extend to the members of the society an invitation to attend the Rhode Island clam bake in connection with their visit to Wood's Hole next year, and the wives of the society members are also invited to partake of this clam bake. You will remember very pleasantly the clam bake we had in connection with the last meeting.

The President: I remember it very well. I can hardly wait for next year.

Mr. Clark: There was one thing in the report of the committee on place that was left out. I beg to have it put in. Mr. Dickerson, through Mr. Ward, extended a cordial invitation to this society to meet in Detroit in 1904, and he was very anxious to make this request now, so that the members could be considering it. I understand that Mr. Dickerson offers to provide a special mail train and special mail bags for each society, or something like that, and take them all over the state.

The President: Are there any further remarks on the paper read by Mr. Stranahan last night?

(No remarks).

Mr. Titcomb then read a paper by Mr. Dwight Lydell on the subject, "The Habits and Culture of the Black Bass."

Mr. Herbert D. Dean, of the United States Fish Commission, Neosho, Missouri, then read a paper on the subject, "Discouragements in the Culture of Black Bass."

Mr. Titcomb: After the discussion on this paper, if there is any, there is a very short paper simply asking questions on bass. If the audience have the patience I should like to see this whole bass matter straightened out this morning. Mr. Clark also has a paper from Mr. Lamkin, the fish culturist, in Georgia.

Mr. Clark then read a paper by Mr. J. B. Lamkin on the subject, "A Few Points on the Black Bass for Discussion."

Mr. Clark then read a paper by Dr. James A. Henshall on the subject, "Food and Game Fishes of the Rocky Mountain Region."

Motion was made, seconded and carried that the discussion of the paper be postponed until the afternoon session.

A recess was taken until 2 o'clock, same day and place.

AFTERNOON SESSION, 2 O'CLOCK.

Meeting called to order by the president.

The President: I regret to be obliged to announce that Prof. Reighard's paper on "The Meaning of the Secondary Sexual Characters of Certain Fresh Water Fishes," and Prof. Reighard's and Prof. Ward's paper on "A Method of Measuring the Efficiency of Quantitative Plankton Nets" cannot be presented this afternoon for the reason that they were unable to make arrangements to get the current to enable them to exhibit the lantern slides.

The secretary, Mr. Peabody, then read a paper by Mr. W. T. Thompson, of New Hampshire, on the subject, "Feeding—Its Effect on Growth and Egg Production."

The President: It affords me great pleasure to announce that Hon. George M. Bowers, United States Fish Commissioner, is fortunately with us. He arrived this noon, and as we have done ourselves the honor of electing him our president, I earnestly request Mr. Bowers to come forward and let me introduce him to the society. (Applause).

Mr. Bowers: Mr. President and gentlemen, I very much appreciate the honor you have conferred upon me, but from the fact that I am not a speechmaker and that I do not desire to delay the business of this society, and from the further fact that quite a number of its members are anxious to leave on the 3:15 boat, I simply at this time again express my thanks and hope to show my appreciation for this honor by endeavoring to do, as I try to do always, my duty. (Applause).

The President: Mr. Bowers' efforts in the line of fish culture have elicited the warmest approbation from people throughout the country interested in that subject, and it will give me great pleasure to deliver the baton of office into his hands when I am through with it this afternoon.

The committee appointed to audit the treasurer's report then

presented their report, finding that the treasurer's report was correct.

Report adopted.

Dr. Birge: I have a paper from Arthur Sykes of Wisconsin, which, if there is no objection, I would like to present to the society.

Dr. Birge then read a paper by Mr. Arthur Sykes on the subject, "Inbreeding Pond-reared Trout."

Secretary Peabody: That concludes the papers.

Dr. Birge: We are all greatly disappointed in not hearing Prof. Reighard's paper and the joint paper of Prof. Reighard and Prof. Ward. I suppose that the absence of the lantern makes it impossible to give them. Would it not be possible, however, for them to furnish for the transactions a general statement of the contents of the papers, so that we could get them in printed form.

Prof. Reighard: I think it would be possible.

The President: As a committee to prepare such biographical mention of the members who have died during the past year as may be deemed proper and in accordance with the usages of the society, I will appoint Dr. Bean, Dr. Birge and Mr. Willard to make report at the next meeting of the society.

Mr. Titcomb: May I enquire if the photographs furnished by Mr. Lydell will be published with his paper?

The Secretary: Yes, I intend to have them in. I have selected some.

The President: I would enquire if the lectures with lantern slides, "A Method of Measuring the Efficiency of Quantitative Plankton Nets," and "The Meaning of the Secondary Sexual Characters of Certain Fresh Water Fishes," could be given in the transactions without the slides.

Prof. Reighard: I do not think so. A good many of the illustrations are colored. I think the most that could be attempted would be an abstract of the articles, perhaps with some illustrations.

Mr. William H. Boardman, of Rhode Island: A good many of us who come here eager to learn are confronted with a rather perplexing situation. These topics are taken up, papers pre-

sented, long and exhaustive discussions had—but no conclusions reached. Now, how are we to decide who is right? I think that by some means a definite decision where possible should be made, settling once for all points which can be settled by us, so that it will not be necessary to take them up again, and so that we may know something of what we have accomplished.

The President: You will have to do as an old German justice of the peace used to do; he always said, "The last fellow got the best speech and I gives him the case."

Mr. Peabody: I move that the society tender a resolution of thanks to the United States Fish Commission for its kindness in putting the steam launch Shearwater at our disposal, and also for the great interest that the commission has shown in being represented here in such large numbers, in furnishing so much material for our discussions, and affording such great help to us in forwarding the work of the society.

Motion seconded and unanimously carried.

Mr. Bowers: I desire to offer a resolution heartily thanking the officers of this association for the conscientious and able manner in which they have performed their several duties, and to congratulate them upon the successful work of this society during the past year.

Motion seconded and unanimously carried.

The President: Before we close I wish to thank the society for the meeting, which to me has been one of great interest and satisfaction. The duties of the presiding officer have been simplified and made very easy by the excellent order maintained. I found it the least difficult convention to manage that I ever presided over, and our meeting has certainly been pleasant and, I hope, instructive to us all. I certainly have derived great benefit and pleasure from the papers and discussions we have had, and want to say to all of you who failed to meet us at Wood's Hole when our last convention was held there, that you will lose a large fraction of the pleasures of life, if you fail to go there next year, for it is certainly worth a trip across the United States to see that country and the work that the United States Fish Commission is conducting there. It will enlarge our vision very much on the subject of fish culture, and its concomitant stud-

ies. Thanking you for your kindness and courtesy to me during my presidency, I now lay aside the mantle of office, proud and gratified that it falls upon such worthy shoulders as those of my honored successor. (Applause).

Mr. Bowers: Before we adjourn, I desire to present to the society Dr. Green, of Dayton, Ohio, representing the Ohio state commission. (Applause).

Dr. Green: The gentlemen in Ohio have been absent from your convention from choice, not necessity. I am glad to say to you that while you have honored our state with your presence, we are sorry not to have been with you more frequently, but we are with you in spirit. We are trying to do the best we can. We have the best game and fish laws in the world, especially in regard to Lake Erie. We have been handicapped very much with our laws there, but we are in a much better position now, and we are going at matters in the right spirit, and intend to enforce the laws. We will have a patrol boat from which we expect great results. I am glad to meet you all and hope to see you at some future time. (Applause).

President Bryant: The society hopes that the commission of the state of Ohio will be with us hereafter and co-operate with us in the good work we are carrying forward, and we wish all fish commissions godspeed. We have appointed a committee to endeavor to stimulate and promote among the various state commissions the best methods of interesting the public and getting a right public sentiment in respect to the protection and propagation of fish.

Mr. Dean: In regard to the meeting next year, I understand there is an invitation for the ladies to come to the clambake. Does that mean we are to bring the ladies next year?

Dr. Birge: Anybody that can get the price of a ticket had better bring them.

The President: There were several ladies at our convention last year and they enjoyed themselves very much, and everything was done to make it pleasant for them. There is a standing invitation to the ladies to come to our conventions.

The society then adjourned sine die.

Deceased Members since last meeting:

James Benkard.

Prof. B. Benecke.

Prof. A. J. Malmgren.

J. S. Van Cleef.

E. H. Friesmuth, Jr.

PART II.

PAPERS AND DISCUSSIONS

THE HABITS AND CULTURE OF THE BLACK BASS.

BY DWIGHT LYDELL.

In this paper I shall try to set down the experiences that I have had in the nine seasons, beginning with that of 1894, during which I have had charge of the Black Bass work of the Michigan Fish Commission. This work was begun at Cascade, Michigan, and after four seasons was transferred to Mill Creek, where it is now carried on. Since the methods of pond culture that have been finally adopted are based on a knowledge of the breeding habits of the fish under natural conditions, I shall begin by describing these habits. The account has reference to the Small Mouth Bass, unless the Large Mouth is specified.

In studying the habits of the bass it is necessary to distinguish the males from the females at a considerable distance. Ordinarily, it is not possible to distinguish them except by dissection, but just at the spawning time the female is distinguishable even at a distance of 10 or 20 feet on account of her distension with eggs. By this means I have been able to make out the part taken by each sex in nest building and the rearing of young. I have several times, while watching the fish, verified my determination of the sex by seining the fish in question and dissecting it, have invariably found that I had determined the sex correctly.

I do not hesitate to say that the nests of the black bass are built by the male fish working alone. The small mouth prefers a bottom of mixed sand and gravel, in which the stones range from the size of a pea to that of one's fist. As the spawning season approaches the male fish are seen moving about in water of 2 or three feet depth seeking a suitable nesting place. Each male tests the bottom in several places by rooting into it with his snout and fanning away the overlying mud or sand with his tail. If he does not find gravel after going down 3 or 4 inches, he seeks another place. Having found a suitable place he cleans the sand and mud from the gravel by sweeping it with his tail. He then turns over the stones with his snout and continues

sweeping until the gravel over a circular spot of some 2 feet in diameter is perfectly clean. The sand is swept toward the edge of the nest and there forms a rim a few inches high, leaving the center of the nest concave like a saucer. The nest is usually located near a log or large rock so as to be shielded from one side If the bank is sheer and the water deep enough, the nest may be

HATCHING BED.

built directly against the bank if possible. It is always so placed that the fish can reach deep water quickly at any time.

During nest building no females are in sight—but when the nest is done—and this takes from four to forty-eight hours—the male goes out into deep water and at once returns with a female. Then for a time—it may be for several hours—the male exerts himself to get the female into the nest and to bring her into that state of excitement in which she will lay her eggs. If she lies quiet he turns on his side and passes beneath her in such a way as to stroke her belly in passing. If she delays too long he urges

her ahead by biting her on the head or near the vent. If she attempts to escape he heads her off and turns her back toward the nest. If, after all, she will not stay in the nest, he drives her roughly away and brings another female.

Some fifteen to thirty minutes before the female is ready to enter the nest and spawn, her excitement is made evident by a change of color.

Ordinarily, she appears to be of a uniform dark olive or

SHOWING BEDS SCREENED.

brown above, changing to a light green below. The only markings readily seen are four stripes on each cheek. In reality however, the sides of the fish are mottled with still darker spots on the dark olive back-ground. The spots are arranged so as to form irregular, vertical bands like those on the perch—but these are not usually visible. Now as the excitement of the female increases the back-ground becomes paler and finally changes to a light green or yellowish hue so that the spots and bands stand out in strong relief. The whole surface of the fish becomes thus strongly mottled. This is a visible sign that the female will soon spawn. The male undergoes a similar but less pronounced change of color.

Soon after this the female enters the nest and the male continues to circle about her, glide beneath her and to bite her

gently on the head and sides. At times, he seizes her vent in his mouth and shakes it.

When this has continued for a time spawning takes place. The two fish turn so as to lie partly on their sides with their vents together and undergo a convulsive fluttering movement lasting three to five seconds. During this time the eggs and milt are extruded. The circling movements are then resumed, to be interrupted, after a few seconds, by spawning. This alternate circling and spawning continues for about ten minutes. The

POND AFTER BEDS HAVE BEEN SCREENED.

male then drives the female away, biting her and showing great ferocity. She does not return.

The male and the male only, now continues to guard the nest, fanning sediment from the eggs and repelling enemies. At 66 degrees Fahrenheit the eggs hatch in five days and the young fish swarm up from the bottom in twelve to thirteen days from time eggs are hatched.

Henshall in his "More About the Black Bass" published in 1898, quotes, with approval, Arnold's observations to the effect that the nests are built and then guarded by the female. Page in the "Manual of Fish Culture" published in 1897, by the United States Fish Commission, speaks of the nests as being built by the mated fish sometimes working together, and sometimes working separately. These seem to be the latest pub-

lished observations,—and are not at all in accord with my observations in Michigan.

After the young small mouth bass rise from the nest they soon scatter out over a space 4 or 5 rods across. They do not form a definite school, with all the fish moving together, but a very loose swarm in which the fish are moving independently, or in small groups. This habit makes it impossible to seine the young fry, as upon the approach of the seine, instead of keeping together, they at once scatter and escape the seine. The fry may be at the surface or on the bottom in weeds or clear water. They are attended by the male until they are an inch and a quarter

POND DRAWN DOWN WHILE SETTING BEDS.

long. The swarm then gradually disperses and the young fry, which were previously black, take on the color of the old fish.

The breeding habits of the Large Mouth Black Bass are similar to those of the small mouth, but differ in some respects which are of importance in pond culture.

1. The nests of the large mouth are not made on gravel, but by preference on the roots of water plants. These are cleaned of mud over a circular area and on them the eggs are laid. As the large mouth eggs are smaller and more adhesive than those of the small mouth, they are apt, when laid on gravel to become lodged between the stones and to stick together in masses. They

are then smothered. When laid on the fibrous roots of water plants this does not occur.

2. The young remain together in a compact school very much smaller than that of the small mouth and the fry usually move all in the same direction. This makes it easy to seine the large mouth fry when wanted.

CULTURE OF BLACK BASS.

1. *Ponds and Stock Fish.*

After some experimenting, all our ponds, both for stock fish and fry, are built on the model of a natural pond. There is a

POND DRAWN DOWN WHILE SETTING BEDS.

central deeper portion or kettle, about 6 feet deep, and around the shore a shallow area where the water is about 2 feet deep. The bottom is the natural sand, and water plants are allowed to grow up in the ponds. All ponds are supplied with brook water, and silt from this furnishes a rich soil for the aquatic plants. The water of these ponds contains Daphnia, Bosmina, Corixa and other small aquatic forms in great numbers. These furnish food for the bass fry. The ponds run in size from 120 feet by 190 feet to 100 feet by 100 feet.

At first we were unable to feed the stock fish on liver, but after a time we found that by cutting the liver into strips of about the size and shape of a large angle-worm and by throwing the strips into the water with the motion that one uses in skip-

ping stones, they wriggle like a worm in sinking and are then readily taken. The liver must be *fresh!* We found, however, if the fish are fed on liver alone they do not come out of winter quarters in good condition. Of eleven nests made by bass thus fed, only three produced fry. Although eggs were laid in all they seemed to lack vitality owing to the poor condition of the parent fish, and in eight of the nests the eggs died.

In order to bring the fish through the winter in good condition it is necessary to begin feeding minnows in September, and to continue this until the fish go into winter quarters.

HAULING DAPHNIA.

The bass eat minnows until they go into winter quarters, after which they take no food until spring. The minnows are left in the ponds over winter so that the bass, when they come out of winter quarters, find a plentiful supply, which lasts them until the spawning season. At this time the minnows are seined from the pond as their presence interferes with the spawning. Before this, however, some of the minnows have spawned and their fry later serve the young bass as food. When bass are fed in this way, they come out of winter quarters in fine condition and their eggs are found to be hardy.

2. *Artificial Fertilization.*

During the first two or three seasons of our work numerous attempts were made at *artificial fertilization,* but like all other

attempts of this sort, these proved to be failures. Only twice did I succeed in artificial fertilization. On one of these occasions the female was seined from the nest after she had begun to spawn. She could then be readily stripped. The male was cut open and the eggs were fertilized with the crushed testes. About 75 per cent of the eggs hatched on a wire tray, in running water, the eggs being fanned clean every day with a feather.

In the second case the fish were seined while spawning and it was found that in the case of one female, pressure on the abdomen caused a reddish papilla to protrude from the vent. This had the appearance of a membrane closing the vent. It was pinched off and the female then stripped readily and the eggs were fertilized and hatched.

3. *Pond Culture.*

Having abandoned artificial fertilization, our attention was next turned to *pond culture* and this we have carried on for about six years. Our earlier ponds were not of a sort to furnish natural spawning ground. For this reason we constructed along side each of the large ponds, six smaller ponds to be used as spawning ponds. Each of these was about 16 by 24 feet, 16 inches deep, with gravel bottom, and was connected to the central pond by a 4 foot channel.

The fish entered these and spawned. In one case we had eight nests in a single pond of this sort. Where as many nests as this were made, usually but one or two of them came to any good, the others being destroyed by the fighting of the male fish. Ordinarily, but one or two nests were built in each spawning pond. The male fish first to enter and begin the construction of a nest, generally regarded the whole pond as *his* property and held it against those that tried to enter after him. On one occasion the male thus holding the pond was attacked by ten or twelve other males at one time and after a long struggle was killed and his nest destroyed.

4. I now gave up the attempt to use small spawning ponds and had nearly all my ponds made of good size and with a central kettle and shallow shore area—as already described. The problem now was to prevent the fighting of the male fish and the consequent destruction of nests and eggs. I finally hit upon

what seemed to be the two chief causes of this fighting and found remedies for them. I had noticed that in the natural water the nests of the small mouth bass were frequently built against a stone or log so as to be shielded on one side. When they were so built the nests might be quite close together, as near as 4 feet, and the fish did not fight, because they did not see one another when on the nest. On the other hand, if a bass nest was built in a situation where it was not shielded the bass on that nest would prevent any other bass from building within 25 or 30 feet of him. It occurred to me then to try to construct artificial nests and shield them so that the fish on the nests could not see one another. In this way I hoped to be able to place the nests so near together so as to fully utilize my pond area and still not have them destroyed by fighting.

In the spring before the spawning season opened, I drew down the ponds so as to expose the shallow terrace along the shore. This terrace was then cleaned to a depth of about 2 inches of sediment and vegetation which had accumulated since the previous summer. Rectangular nest frames 2 feet square of inch board were now made. On two adjacent sides these frames were 4 inches high, while on the other sides they were 16 inches high. They were without bottoms, that is, were frames not boxes. The frames were then set on that part of the bottom where there would be about 2 feet of water when the pond was filled. Each was so set that the corner formed by the junction of its two lower sides pointed to the center of the pond while the opposite corner formed by the higher sides pointed toward shore. The frames were set directly on the bottom, not in excavations and each was filled with gravel containing sand and suitable for nest building. A board was laid diagonally across the two higher sides and a heavy stone laid on this to keep the frame in place. The effect of the two higher sides of the frame is to form a shield on two sides of the nest; while the board across the top affords shade. The frames were set in two rows about the pond, parallel to the shore line.

The rows were about 6 feet apart and the nests in each row about 25 feet apart, alternating with those in the other row. There was thus about one nest to each 100 square feet of suitable bottom, or in each area 10 by 10 feet. When the bass were on

the nests no one was able to see any other and the fighting from this cause was practically eliminated. The number of rows of nests may be increased to three, or four, or more where the area of shallow water is wide enough.

The bass selected these nests in preference to any other spawning ground. They cleaned up the gravel and behaved in the nests in every particular as they would on natural spawning grounds. The first time we tried these shielded nests, not a single bass made a nest outside them, though there was plenty of good gravel bottom available for the purpose.

I come now to the second cause of fighting. The first season that we tried these nests (1900) we got from 475 stock fish 315,000 fry and 750 fingerlings. In the season of 1891 the output was very much less and there was considerable fighting among the fish. This remained unexplained until the ponds were drawn down after the spawning season, when it appeared that, although the fish had been sorted, the number of male fish was considerably in excess of the number of females. It was these excess males that had made trouble. Banding together they went about breaking up the nests of their more fortunate brothers. It is now our practice when we set the nests to seine out the stock fish and sort them putting about forty males to sixty females. Since each male is thus abundantly provided for, the second source of fighting is gotten rid of.

During the present season up to May 26th we had produced from 493 adult fish 430,000 fry—and we believe that we can do as well every year.

5. Up to the present year we have been troubled with two sources of *loss incident to our water supply.* The supply is a spring fed brook which runs over an open country before it reaches us. The water in this brook becomes quite warm on a hot, sunny day and cools off at night. The temperature thus falls at night sometimes as much as 13 degrees Fahrenheit and becomes as low as 46 degrees Fahrenheit. This is disastrous, since, when the temperature gets below 50 degrees Fahrenheit the adult fish desert the nests and the eggs or young fry are killed by the sediment. We have lost many fish in this way. We now get over the difficulty by watching the temperature of the

water and when it approaches 50 degrees Fahrenheit, we shut off the supply and keep it shut off until the water warms up. Since the ponds are well stocked with water plants the fish do not suffer from lack of oxygen when the water is shut off. Indeed, if the water did not leak out of the ponds I doubt if it would be necessary to introduce any running water into them during the breeding season.

The *second difficulty with our water supply* has been from sediment brought down by the brook after heavy rains which has sometimes accumulated over the nests so thick as to smother the eggs and drive away the parent fish. This difficulty also we now get over by shutting off the water supply whenever the water is much roiled.

The only difficulty with shutting off the supply is that the level of the water must be kept fairly constant. If it lowers more than about 6 inches, the fish leave their nests and the eggs die. For the purpose of maintaining a constant water level it would probably be best to have the ponds made with clay bottoms. The difficulties arising from roily water of variable temperature are, however, local and would probably not be usually encountered.

6. I have still to speak of the *handling of the fry after they rise from the nest and of rearing them to fingerlings.*

The fry of the small mouth have the habit of scatttering into a large swarm when they leave the nest, and it is consequently difficult to seine them when wanted. I have therefore adopted the practice of setting over each nest, just before the fry rise from the bottom, a cylindrical screen of cheese cloth supported on a frame of band iron. I first remove the wooden nest frame. The screen keeps the fry together. They thrive and grow within it and may be left there until one desires to ship them. The old fish stays outside and watches the screen. The fry feed on the crustacea inside the screen. When this supply is gone other crustacea may be taken from the pond with a tow net and placed inside the screen. We remove the fry from these screens directly to the shipping cans as wanted.

In order to raise fingerlings, I lower the water in one of the ponds, seine the old fish out of the kettle, and transfer them to

another pond. Then I refill the pond and put in my fry, now about one-half to three-quarters of an inch long. The water in the pond is thick with Daphnia and other crustacea and these do not go out when the water is drawn off. The fry feed on them and the supply is usually sufficient—but if it gives out, a fresh supply may be gathered from one of the other ponds and placed in the nursery pond. As the young bass grow they eat not only the Daphnia but young Corixa and doubtless other aquatic animals.

In 1901 fry one-half to three-quarters of an inch long were introduced into the nursery pond on July 12th, on August 5th they were seined out and shipped and were then 2 to 3 inches long. They had had none but the natural food! In three months these fish, under the same conditions are 4 to 6 inches long.

7. I have spoken so far of the small mouth and it remains to say *something of the large mouth,* with which my experience is more limited. It is less necessary to resort to pond culture with them since, owing to the habit of the fry of keeping in a close swarm, they may be readily seined from their natural waters shortly after they have left the nests.

In culturating them in ponds I use the shielded nests already described,—but make the bottom of some fibre, preferably Spanish moss bedded in cement, similar to those used by Stranahan described in the report of this Society for 1900. This imitates the natural nest bottom and gives better results in our locality than the gravel nest. I do not place screens about the nests, since the young fry are so small that it is difficult to hold them with a screen and since they may readily be taken with a seine when wanted. I allow the large mouth fry to leave the nests with the parent fish and seine them when wanted.

Finally, I will sum up what seem to me to be important points in pond culture of small mouth black bass. I assume the ponds to be constructed, as is usual, on the model of a natural pond with a central kettle and shallow shore region. They should be well grown up with water plants and should be supplied with lake or brook water.

1. Fish should be so fed (with minnows) as to be in good condition in the spring.

2. They should be sorted into the ponds in the spring in about the proportion of four males to six females.

3. Shielded nests should be used, arranged as already described—about one to each 100 square feet of shallow water.

4. The gravel used in the nests should be carefully selected; it should contain sand and plenty of small stones.

5. Water on the nesting grounds should be kept constantly at a level between 18 inches and 2 feet.

6. The temperature of the water should be kept constantly between 66 degrees and 75 degrees Fahrenheit (in our locality).

7. Roily water should be as far as possible kept out of the ponds during the spawning season.

8. Fish should not be disturbed until the eggs are hatched.

9. The small mouth nests should be screened just before the fry rise from the bottom.

10. The water should contain an abundance of natural food for the fry.

In closing I may say that I can see three ways in which my procedure might be improved.

1. I should provide special nursery ponds for rearing fingerlings.

2. I should try nest frames shielded on three sides instead of on two sides. I should make them with a bottom and when the fry rise from the nest I should close the fourth side of the nest frame by sliding a screen into it. In this way I should not have to remove the nest frame and put a screen over the nest, but would simply leave the frame in place and close the open side with a screen.

3. I should make the ponds with clay bottoms, so that if necessary the water supply could be entirely shut off during the breeding season.

FROM MILL CREEK HATCHERY:

Total output during year, ending at present time:

Small-mouthed bass fry	404,000
Big-mouthed bass fry	618,000
Fingerlings	36,050
Total	1,058,050

DISCUSSION OF MR. LYDELL'S PAPER.

Before his paper was read, Mr. Lydell said: On the subject of the black bass we have not committed ourselves to anything, because the more you say about this question, the less you have to take back later on.

At the conclusion of his paper, he said: And in closing, gentlemen, I wish to thank Professor Jacob E. Reighard for assisting me in preparing this paper.

Mr. Clark: This is a very valuable paper and Mr. Lydell has given the bass question as much study probably as any man in the United States. There is one problem of bass culture in which I am greatly interested and upon which I should like to hear from some of the bass men, for I am no bass man myself, although I have bred a few. We have those here who have given the subject a great deal of thought, and the one particular question to which I have reference is in regard to the planting, whether they think that bass fry deposited when two or three weeks old, are as valuable for our lakes and streams as those planted when three or four inches long, as fingerlings.

The President: I regard the paper as very interesting and valuable and one that is entitled to great attention, as Mr. Lydell may be regarded as one of the pioneers in this pond culture of bass.

Mr. Stranahan: In order to get this matter started a little bit, I would like to ask Mr. Lydell what he considers fry in his specimens.

Mr. Lydell: The small-mouth bass I consider fry the moment they commence to swim, and the moment they commence to swim up they commence to take food; and I consider them as fry, though before we get through shipping some of them are an inch long.

Mr. Stranahan: Show me what you commence on, if you please.

Mr. Clark: I would like to have Mr. Lydell tell us at what time they cease to be fry and become fingerlings, or perfect bass.

Mr. Lydell: The difference between fry and fingerlings is this: After they have changed their color, after they take on the color of the old fish, they are then one and a half to two

inches long, and then we commence to call them fingerlings. We have got to establish a point somewhere.

Mr. Clark: About how old are they?

Mr. Lydell: About 40 days old.

Mr. Clark: Then one that was 15 to 20 days old you would not call a fingerling?

A. No, sir.

Q. I would like to ask the question: Is not a large-mouth bass as perfect a fish at 15 to 20 days old in a temperature of water at 70 degrees, as one three months old?

A. It is at 20 days as perfect a bass as at three years.

Q. I would like to ask further, if you do not think that this fish planted in that water is equally as good with the exception of the protection you give to it, as one three to six months old?

A. Yes, sir.

Mr. Clark: The society will perhaps remember that I have always been a yearling man, but I am not so considering bass. Gentlemen, this is the point I am trying to get at. I do not like to see it undertaken to raise only about 50,000 fingerlings out of a half million fry, for I heard one superintendent say last night that it took half a million with him to raise 50,000 fingerlings. Now, if these fish are as well and perfect at the age of 20 days, and Mr. Lydell can plant 300,000 out of 500,000 at that time, and only 50,000 from three to six months old, then I think it is time that the matter was looked into.

Mr. Stranahan: I am of Mr. Clark's opinion, thoroughly. I have been advocating it for two years—made recommendations, and have written official reports urging the planting of these smaller bass. They are perfect bass, they are taking their food, they are old enough and smart enough to take care of themselves, and they are afraid of their enemies. Our former chief of fish culture was a great stickler for fingerling, and the larger the better, and we had it out in numerous discussions, and I am glad to say that our new chief of division seems to be in favor of planting smaller fish and more of them. I refer to the large-mouth bass—I have had little experience with the small-mouth variety. I had some experience north some years ago, and got good results from planting fry in streams in which the fish were

not indigenous. We got splendid results there from planting fry of the small-mouth bass.

Mr. Titcomb: I do want to say about this paper that I feel as if I was amply repaid for coming here just to hear it, if I did not hear anything else during the session; I think it is the best article on black bass I ever saw, by far, and I think it is going to help all the members of the United States Fish Commission to solve this bass problem. From what experience I have had since I came into my present position, I find that we have not solved this question. Mr. Leary has been planting fry at San Marcos with good success; this year a beginning was made at Mr. Stranahan's station of doing the same thing. While I have been a fingerling man to a certain extent, yet my views about the bass are that they are well able to take care of themselves when they are young, and it is much better to plant half a million or a million of these fry than it is to wait until you can plant only a hundred thousand, with the balance inside of the hundred thousand.

I wanted to ask one question about temperatures: What extremes of temperature will the adult fish stand in your waters?

Mr. Lydell: We have a temperature of 90 degrees there sometimes during the day. During the spawning season we must be very careful about the temperature. On a warm day, with lots of sun, the temperature may go up to 72 degrees, but when you get up the next morning and you have a temperature of 49 degrees or 50 degrees, and if any bass have spawned during the previous day you will find that the bass have deserted their bed and that the eggs are dead. But the temperature does not range much higher than 90 degrees for more than a few days, but during the summer months, after the spawning season, the water is allowed to run all the time, and it will cool down to 60 degrees every night during the summer, and the minute the sun strikes it in the morning it will commence to warm up, and as soon as the sun goes down the springs flow in, and of course it is cooled again, but our fish do not seem to take any harm from it at all.

Mr. Titcomb: One more question: In this water of yours is it equally favorable for both the large and small-mouth bass, or do you want different qualities of water for the two varieties?

Mr. Lydell: I have experimented some with the large-mouth bass this year and last year, and I find the water very favorable for them. Prof. Reighard saw us haul 48,000 large-mouth bass nearly an inch long at one dip of the seine in one of our ponds. We had only 30 specimens of the large-mouth bass at our hatchery this year, and from those I think there were obtained something over 100,000 fry, although only five productive beds were made. They were a scattering lot we picked up and did not know whether they were male or female. We put in the same pond quite a lot of small-mouth bass, and the two varieties did not quarrel or injure one another at all. The large-mouth bass were allowed to roam about the pond with 75 or 80 of the old small-mouth bass, and the small-mouth bass that spawned in there were in fifteen beds, and we screened those and took care of them in the usual way. There was plenty of daphne growing in the pond and lots of food for the large-mouth bass; and these bass that I have here were from that lot.

(Referring to specimens).

This bass thirty days old I took from the nest and put in a cage and kept there, and in that way I kept accurate account of them. (Referring to specimens).

Mr. Titcomb: You must have an unusual amount of aquatic life in the ponds.

Mr. Lydell: You can dip it up with a dipper anywhere around the ponds in the spring. We have to mow our ponds twice every year.

Mr. Stranahan: Is the water hard or soft?

Mr. Lydell: Some soft, and lots of spring water.

Mr. Stranahan: Is there lime in that?

Mr. Lydell: No, no lime.

Mr. Titcomb: Is there any other kind of plant life than you have named in the paper?

A. There is the cara and potamogeton, that is all.

Mr. Titcomb: You did not get all the large-mouth bass of which you mention, the total output, from these ponds—did you?

Mr. Lydell: No, sir, we had two auxiliary ponds. One is a small pond connected with the Soldiers' Home, from which we get lots of large-mouth bass, and another one we have rented, of

the extent of probably one and a half acres, from a farmer. That is where we get our large-mouth bass from now, principally. We have no room there to hatch them with the exception of what I have hatched there this year, about 100,000.

Mr. Titcomb: Did you ever see any large-mouth bass flirt with a small-mouth bass, as described in the paper?

Mr. Lydell: Not a particle: We had a pond where the large and small-mouth bass were mixed up purposely—the old ones—and the beds around the shore alternately were some of them Spanish moss beds and some gravel; and we had two pair of large-mouth bass that spawned on the gravel; although they did not amount to much. Their eggs settled down in between the stone and seemed to smother. On the other hand we had three pair of small-mouth bass that spawned on this fiber, and we got excellent results from them, but I think the reason they *did* spawn there was because they seemd to clean down and try to fan off that fibrous matter, and could not, but got to the cement and thought it was rock, and spawned there. But we had one trouble—we could not raise the nest away and screen it. If we made a screen big enough to get the whole nest, we could not catch the young bass.

Mr. Titcomb: As I understand it, it is necessary for the preservation of those eggs that the parent fish should fan them.

Mr. Lydell: Yes, sir, I think so.

The President: In our ponds at Minocqua we excavated them there and found the spring water coming in out of the gravel in considerable quantities. Do you think that was a detriment or advantage?

Mr. Lydell: It would not be a detriment unless there was too much of it. If you could get a temperature of 66 degrees and keep it there, I do not think the spring water would affect your bass in the least.

The President: What are the best dimensions for ponds for bass growing?

Mr. Lydell: If I were to rebuild our ponds over at Mill Creek, where I have these ponds, I would make them larger. Our last pond we built is the most successful.

The President: What is your judgment, Dr. Birge, of the dimensions of our ponds at Minocqua?

Dr. Birge: The lower pond must be about 300 feet long and the others 150 to 200 feet.

The President: And 60 or 80 feet wide?

Dr. Birge: Yes.

Mr. Brown: If there is much spring water coming into the bed the temperature would be too cold, would it not?

Mr. Lydell: Yes, if they could not keep the temperature up.

Dr. Birge: The spring water does not affect our temperature. It is a sort of a seepage spring, not a strong flowing spring, the temperature being somewhere in the region of 50 degrees Fahrenheit, and the lake water offsets what little spring water comes in. I should like to hear more about this matter of the size of the pond; and especially as to the margins.

Mr. Lydell: I have here a view of one of our ponds, 190 by 120 and six feet deep in the center. There is a margin of probably thirty feet clear around the pond and there is an island here; it has a shallow margin clear around the island to the shore, and there is a big pocket in the center of the pond 50 by 30, and six feet deep, and that is all the deep water we have in the pond, and that runs gradually to six feet. You will find the fish there invariably in the winter time, and all summer, unless they come out for minnows.

Dr. Birge: The broad margin of your pond is a decided advantage, of course. You need that for a spawning bed. If you made your pond large, would you make it irregular in outline so as to give you more margin?

Mr. Lydell: I would. Our ponds are nearly all irregular, and we get better results thereby.

Mr. Stranahan: What do you consider a proper number of small-mouth or big-mouth bass for an acre of water, everything being favorable.

Mr. Lydell: I would put into an acre, I should judge, about something like 200 females and 160 males, small-mouth bass.

Q. You would not think that excessive?

A. No.

Q. How about the big-mouth bass?

A. I am not posted on that.

Q. What is your opinion about it?

A. I would not put as many in in this little lake that we rented. By the way, I think renting that little lake was one of the greatest things that the fish commission ever allowed me to do. I rented it for $10 a year, if the output does not exceed 75,000, and if it does, I must pay the gentleman $15. Of course that is a lot of money.

Dr. Birge: That must affect your $75,000 considerably.

Mr. Lydell: I put the first season into that lake 48 or 50 fish raised at the hatchery, two years old, large-mouth bass. I think it was something like 60,000 or 70,000 fry I got out of there the first season, and last fall I procured forty-four or more large-mouth bass, adults, weighing anywhere from two to three pounds, and put them in there. I also put in a couple of wagonloads of minnows, probably 50,000 or 75,000. This year we got from that pond 262,000 fry, and 8,000 fingerling, and I was quite sorry that it went to that number, because the fish commission had to put up another $5. (Laughter). We have absolute control of this pond, and it is covered with chara nearly all over, with the exception of a little in the center; and on one end there are some pond lilies. It is nothing but mud; you cannot wade anywhere near it without rubber boots, and then you are liable to drop through the bogs, and there is only one place for them to spawn, and that is on the pond lily roots; and we had bass beds in that lake this year that were over ten feet across, and I went there as the young bass were coming up off the beds, and I presume two or three pair of bass must have spawned on that particular spot, for the young bass were coming up all over that bed, where it had been cleaned. You could see them if the sun happened to be just right. We let those alone in that pond—paid no attention to them—until they were about 15 days old, when they were all taken out of there, and nearly every fish that was shipped from that pond was one and a half inches to one and three-quarters long, and we took them with a seine.

Mr. Titcomb: What was the area of that pond?

A. I should judge it was about an acre and a half—it is a small pond.

The President: Let me ask you a question on another line: At our Minocqua hatchery we are right in a nest of bass lakes,

and every spring we can catch with our seines easily and without trouble, enough bass to put into our ponds. Now, would you prefer that method to keeping them in constant confinement? If you were situated so that you could get your brood fish by going right out into the wild lake and seining them and putting them into the ponds during the season of propagation, would you do that or would you keep them in stock all the time?

Mr. Lydell: If I could I would get my spawning fish in the fall of the year—what I need—I would hold all I could in my ponds and feed them, domesticate them as much as possible. I find that the wild fish when spawning season comes on are very shy; they will come up on the shore and make their nests, and if you happen to go along there, which we do not allow anyone to do during the spawning season—no visitor or employe is allowed to go around the ponds during the spawning season unless it is absolutely necessary—our superintendent cannot go down there unless it is absolutely necessary for him to go—they go just enough to feed the fish—I find that when these wild fish come out and spawn, they scoot off to deep water on the slightest provocation—they rush back and forth all the while. But our fish that we got the latter part of the year were domesticated so that you could get within ten or twelve feet of the nest and see the bass lying under the shadow of the board, guarding his bed. Of course if you went up close he would go away, but he would come right back, and I have oftentimes waded right up to the bed, put my hand on the stone, and the bass were lying there. Those were domesticated bass that we have had there several years.

Mr. Clark: Don't you think they are acquainted with Dwight Lydell and know him, so that they don't go away?

Mr. Lydell: I could not say as to that, but they say good morning to me every time I see them. (Laughter).

The President: Mr. Lydell has satisfied me that there is a good deal of human nature in bass, even to a degree of modesty in courtship. (Laughter).

Dr. Birge: I should like to ask a question along another line: You spoke in the suggestion at the end of your paper, of making the boxes protected on three sides, and then putting a screen in on the fourth side to avoid moving the nest frame

and putting a screen over the nest. If that were the case, should not the sides of the boxes be made high enough to stick up out of the water?

Mr. Lydell: Certainly—our boxes that we have now with protected sides are sixteen inches high; but I will raise the new boxes up above the two-foot level.

Dr. Birge: You will get circulation of water enough if you have a three-sided box coming up out of the water?

Mr. Lydell: Yes, sir, the three sides enclosed will have a strip of copper wire screen four inches wide around, near the surface of the water. With these boxes I am using now the difficulty is this, you have to wade out into your pond to take the boxes out of there, and you have to take them out. If you screened the box itself, you could not collect one fiftieth of the fry. Just as quick as you put your net in the water the fry will go to the frame immediately. But when you raise the frame out, it is filled with gravel, and the young fish are at the bottom. The sides of your gravel fall away and lots of your little fish fall outside, and some are buried in the gravel, and you roil up the whole pond. I have lost quite a few fish from that cause, although most of them are far enough along when you screen them so that they would not become injured. But with the other screen, all you have to do is to paddle around with a boat and drop the screen in at the side that is not protected.

Mr. Stranahan: How do you take the fry out of your box?

Mr. Lydell: In the same way as out of a screen. It answers the same purpose as a screen—it is a screen and box combined, and you can use the box for large-mouth or small-mouth bass as you see fit.

Mr. Stranahan: You would not make your strip of netting in the side more than four inches wide, and have it up near the top of the water?

Mr. Lydell: Yes.

Q. What mesh do you use?

A. Fine enough to hold young fry. We used the common wire that they buy for door screens, for our small-mouth bass, had it tarred two heavy coats, which lessens the size of the interstices somewhat. We do not screen any large-mouth bass.

Mr. Titcomb: When you take the fry out of the nest, you

raise the nest right up, do you? I refer to the boxes that have three sides of wood and one of screen:

Mr. Lydell: Take a dip net and dip them right out. We usually take a boat, or if some of the boys have boots on, they take a tub and dip the fry out and get them all that way.

Mr. Stranahan: Is there an opening in the top of the screen?

A. Yes.

Q. And by the screen you propose now the box is open on one side with top, and to remove it you take the stone on it off?

A. We have no stone on it—that is unnecessary.

Q. You would have that loaded down with your nest inside?

A. Yes. You might lay a board across the top for shade, if necessary.

Mr. Titcomb: Do you draw your pond down in removing your fry from your boxes?

A. Never.

Q. How much water is there in the boxes?

A. Twenty inches to two feet. Young small-mouth bass are all at the top on a sunny day, and you can get two-thirds of them the first dip; then you wait awhile and they will come up again, but it will be two or three days before you finally clean up the whole school.

Q. That is before they are trained to say good morning?

A. Yes, sir. (Laughter).

The President: How high is the sand at the bottom of your box above the bottom of the box?

A. Four inches. We fill it full and concave it a little in the center.

Q. Where you had a great deal of seepage from the bottom, would it not be better to raise it a little more?

A. There would be no harm in doing so. We used to use six and seven inches, but found four inches just as good in our locality, and we do not have so much to clean out of our ponds in the fall.

Mr. Stranahan: Suppose you are going to corral the big-mouth bass. Our big-mouth bass spawns every three months. So it would be important if we could clean up the whole school and have none left to eat up the subsequent brood. Now, if you

substitute your cement and Spanish moss for the gravel in the rig you describe, would it not work all right?

A. Yes, sir, if you want to ship the big-mouth bass when they first rise from the bed.

Dr. Birge: If you followed Mr. Lydell's last plan I do not see any difficulty if you wish to just take that nest after screening, right out.

Mr. Lydell: I have done that, but got no results. We had last year a lot of large-mouth bass spawn in this pond and I did not want them there, and I watched them till they were about ready to hatch, and I raised the nest up; I had added a bottom in it of this cement, and after I raised it above the water there was still two inches of water in the nest covering the eggs. I transferred those to a pond 16 x 24, and put in three or four quarts of daphne, but got no results. In the fall I think we had probably thirty or forty bass out of these three schools, where we ought to have had fifty thousand.

Q. If you had used the box and screen on the large-mouth bass when the bass had risen, you could lift the nest up and dump the bess out, couldn't you?

A. Yes.

Mr. Stranahan: I would be of the opinion that Mr. Lydell's plan of dipping them out would be better.

Mr. Lydell: If I did not want any in the pond I would dip out what I could and before taking the screen out of the nest I would take it out on the shore and rinse it out.

Q. Didn't you find that your Spanish moss rotted off toward the close of the season?

A. No, sir; I had Spanish moss that I had used two seasons, and it is in good condition for another year yet. I have used excelsior and used sea grass of some kind, and several other things. They spawned on it all, but it was only good for one season, and so I threw it away and used Spanish moss.

Mr. Stranahan: With us, late in the season it rots off. Though our water is very warm, standing 90 degrees, every day, and during three or four months running up to 100 degrees, and I think the high temperature has a tendency to rot it.

Mr. Lydell: Our beds are hardly ever in the pond more than thirty days.

Mr. Stranahan: Our beds would be occupied by succeeding bass.

Mr. Peabody: You speak of your pond that you rented, of an acre and a half, on which you raised large-mouth bass. Don't you mean to convey the idea that you have more success in that pond raising large-mouth bass than you do in your regular artificial ponds?

A. No,sir; from five beds I had something like 100,000, which is a great deal larger per cent than I had the other way.

Q. How many did you get from this one and a half acre pond?

A. Two hundred and sixty-two thousand.

Q. Were there any other fish in that pond?

A. Very few; that is the reason I rented the pond. There were a few sunfish, very small, some minnows, but hardly anything else; and there was plenty of vegetation there. In another instance we rented a lake probably four acres in extent, and put in 250 or 260 large-mouth bass, and got no results at all. There were lots of other fish, turtles, eels and everything of that kind, and our results from there were very unfavorable. In the Soldiers' Home pond two and three years ago we did very well; but this season the pond has become full of suckers, sunfish, blue gills and turtles, and our bass propagation there is commencing to dwindle. Unless we can draw that pond down and get rid of all those enemies, we will meet with failure there another year; but if I had the same pond where I could control it and draw it down as I wanted it, there would be no trouble to get a million bass from that one pond. The pond is about an acre and a half in extent.

Q. What do you consider the most injurious to the raising of bass—what enemies?

A. Small sunfish and minnows I have found do more to destroy the young bass than anything else in the world that we have ever found. I do not find that any beds are destroyed; I never found the beds destroyed, but in one of our ponds last year I carried on an experiment for my own benefit. I had, I think, fifteen beds of large mouth bass eggs. That pond was alive with minnows, and the vegetation grew up there early. About the time the young bass were coming off the nest, there

was plenty of vegetation in the pond and those minnows cleaned up the large-mouth bass so that we did not get twenty-five bass out of that pond. This year with one-third the amount of bass I got nearly 100,000, but there were no minnows in there.

Q. How old must the bass be before they can be destroyed by the minnows?

A. The moment they rise from the bed, that is, when the destruction comes; if they do not destroy them for a couple of weeks they are not going to do it.

Q. Then would it not be wise not to ship or plant the fry until they were of a proper age?

A. I never would plant the fry of the large-mouth bass, because what you call fry of the large-mouth bass are very small.

Mr. Stranahan: And there is not much loss up to the time when they become a perfect fish one and a quarter inches long?

A. No; we never ship large-mouth bass until they are nearly two weeks old.

Dr. Birge: Two weeks old means two weeks after they have begun to rise?

A. Yes.

Mr. Titcomb: If you had put the two weeks-old large-mouth bass into that pond where the minnows destroyed the product of your fifteen or twenty beds, would they then have held their own against the minnows?

A. They would. We tried that this year. In this pond I had large-mouth bass in, I had let a school come up; they were second breeding, and I had already introduced into that pond for the old fishes' benefit, several thousand minnows, and this brood came up just after we put those minnows in.

Q. That is conclusive evidence that it was safe enough to plant them at that age?

A. Yes. Most of our large-mouth bass this year we commenced planting at that age. We ship out an immense amount of what we call baby fingerlings.

Mr. Titcomb: These fish two weeks old that escape the minnows, do it by being too quick for the minnows?

A. Yes; the minnows have hard work getting them. I have watched a school of bass of that size moving along the shore.

and have seen a sunfish five inches long go into that school with a vengeance and not touch one bass.

Mr. Clark: I would like to ask Mr. Lydell why he calls this a baby fingerling and this a fry?

(Mr. Clark refers to two specimens, the first specimen being small-mouth bass, twenty days old, and about one-half or three-quarters of an inch long; and the second specimen being small-mouth bass thirty-two days old, about one and a half inches long, both specimens being perfect fish).

Mr. Lydell admitted a few minutes ago that this was a perfect bass. (Indicating the smaller of the two specimens).

Mr. Lydell: It is a perfect bass.

Q. And at that age will do just as well to plant as when from three to six months old?

A. Just as well.

Q. Then why do you make the distinction—one is equally as good to plant as the other?

A. Yes, sir, the only reason that we do not plant them all at that age is because we do not get time to do it. We commence planting and plant right along as fast as we can.

Q. You call that a fry? (Referring to first specimen).

A. We do in our shipping.

Q. And call this a fingerling? (Referring to second specimen).

A. Yes.

Q. Now, from the remarks made heretofore, it is as well to plant that, because that is a fish, not a fry? (Referring to first specimen).

A. Certainly.

Dr. Birge: You ought to draw the line when they commence to say good morning. (Laughter)

Dr. Bean: I think it is a proper distinction to call it a fry up to the time when it has absorbed its yolk-sac, and then call it a fingerling. A fry, as I understand it, is a fish which has not yet absorbed its yolk-sac.

The President: Mr. Lydell suggests that the best method is to capture your stock fish in the fall and keep them in confinement during the winter in order to be domesticated. What is the best means of subsistence for fish during the winter?

Mr. Lydell: Our small-mouth bass I cannot see take a thing during the winter; they lie perfectly dormant, going into winter quarters as the pond commences to freeze up. We commence feeding the liver just after the spawning, and continue that until along in September, and then they will be fed minnows until they go into winter quarters. When our fish went into winter quarters last year you could see minnows in abundance, and they had all they wanted; and this spring when we drew the ponds out we had to seine out thousands of them and put them away until the spawning season was over.

Mr. Peabody: I would like to ask a question on this subject: As I understand, trout fry, that has come down to a commercial basis, and they are raised commercially and sold—have you any idea how much it would cost commercially to raise bass fry?

Mr. Lydell: I don't know as I could state, except in one instance, because it cost the commission fifteen great big bucks to get 262,000 of them. (Laughter) If you have a pond that is successful the cost is very small, because there is nothing to be done to your ponds in the winter, only to keep the water running.

Mr. Henry T. Root, of Providence, R. I.: It is a fact that in the eastern ponds small-mouth bass are not dormant during the winter. Under natural conditions in a pond of 2,000 acres they are not at all times dormant during the winter. We frequently catch one or two or three in a day's fishing for pickerel. On one occasion a friend of mine caught over sixty through the ice, and that shows that they do not at all times lie dormant throughout the winter—that is, that they do feed, with us.

Mr. Lydell: I never had such experience.

Mr. Titcomb: Did you see the fish?

Mr. Root: No, but I know they were caught—no question about that.

Mr. Lydell: Some men were hauled up before the court a while ago for catching black bass, by the game warden. I was out there; Mr. Palmer was there also. The trial was had and they claimed that those were small-mouth bass caught in the winter, and the man got a new trial, and I came down and found they were nothing but the large-mouth bass. I have never

been able to catch small-mouth bass through the ice in winter, although I have heard of them being so caught. Some were said to have been caught through the ice at Kalamazoo, but the fish proved to be the large-mouth bass.

Dr. Bean: I can add something on the subject of black bass, because I have had them under observation in aquaria for some years at a time, and what I saw there partly corroborates Mr. Lydell's studies and partly differs from them. But we must bear in mind the fact that an aquarium is a different body of water from a pond, because the temperature is more or less under the control of the people in charge. I have seen the bass of both species take live minnows in the winter, but not often. Of course it is quite an advantage to have a fish before your eyes and to see what he does. We noted in the New York aquarium that the bass for the most part were dormant, but occasionally, whether it was because there was a little accession of temperature or not I do not know, they would rush at a live minnow and take it in just as lively a manner as at any other time during the year.

Mr. Palmer: At Jackson, Michigan, last winter, I know of twelve or fourteen arrests made for catching bass through the ice. I saw the bass and got them—and know it was done.

Mr. Lydell: Were they large or small-mouth bass?

Mr. Palmer: They were considered small-mouth, but since the trial at Three Rivers I am frank to say that I would not like to stake my reputation on it.

FOOD AND GAME FISHES OF THE ROCKY MOUNTAIN REGION.

BY DR. JAMES A. HENSHALL.

In the Rocky Mountain region there are three distinct groups of trout belonging to the *Salmo* genus: the red-throat or cut-throat, or as it is known by the United States Fish Commission, the "black-spotted trout;" the rainbow trout and the steel-head trout. They are all black-spotted. In widely separated sections of country they may be readily distinguished by certain characteristics, but in localities where they co-exist, naturally, it is sometimes difficult to distinguish one group from the others; indeed, at one time the rainbow and steel-head were pronounced by competent authorities to be the same fish, the steel-head being supposed to be the sea-run form of the species. At the present time they are held to be distinct.

The Dolly Varden, or bull trout, belongs to the genus *Salvelinus*, and is related to the brook trout of eastern waters, having also red spots. While the red-throat trout inhabits both slopes of the Rockies, the others named were originally confined to the Pacific slope.

The great lake, or Mackinaw trout, and the grayling are native to Montana. The former is found only, so far as I know, in Elk Lake at the head of the Jefferson river, while the grayling exists, naturally, only in the tributaries of the Missouri river above the Great Falls. It is worthy of remark that these two species are found nowhere else west of Lake Michigan, except in the Arctic region. It is fair to imagine that they were carried there on an ice floe during the glacial period, and it is not unlikely that both species were carried to Michigan waters by the same means, and that the Arctic grayling is the original species.

The small Rocky Mountain whitefish *(Coregonus Williamsoni)*, is abundant. It is a good game and food fish, taking the artificial fly as readily as the trouts, but is popularly not so highly esteemed. It grows to about the same size as the red-

throat trout, and is, in my opinion, fully its equal for the creel or the table.

THE RED-THROAT TROUT. *(Salmo clarkii).*

The red-throat trout is the most widely distributed of all the Rocky Mountain trouts. It inhabits, naturally, both slopes of the Great Continental Divide, and as might be supposed from this extensive range it varies in external appearance more than any of the trout species. There are a dozen or more well-defined sub-species or geographical varieties, but all have the characteristic red splashes on the membrane of the throat. By means of this "trade-mark" it may be readily distinguished from the rainbow or steel-head or other trout. But while it varies considerably in contour, coloration and markings, in different localities, it is identical in structure wherever found. It was originally introduced to eastern waters as the California trout or Rocky Mountain trout, and at the present time is known as the "black-spotted" trout. The latter name is extremely unfortunate, as the rainbow and steel-head are also "black-spotted." The name red-throat trout is distinctive, and is preferable to the rather repulsive name of "cut-throat" trout by which it is also known.

The red-throat trout is commonly called the "brook trout," or "speckled Mountain trout," in the mountain region, which is also an unfortunate designation, as the eastern brook trout is now being introduced in the same waters. When it grows to a large size it is sometimes called "salmon trout," as in Yellowstone and other lakes, but the only salmon trout is the steel-head. The red-throat trout rises more freely to the fly than the eastern brook trout, though in gameness and flavor it is hardly its equal. Its habits are also somewhat different. It usually lies in pools and holes like the salmon, and does not frequent the riffles so much as the eastern trout. In size it is somewhat larger than the eastern trout in streams of the same relative width and depth, and like the eastern brook trout grows larger in lakes.

I have taken them weighing from three to five pounds in Soda Butte Lake in the Yellowstone National Park, and in Yankee Jim Canyon on the Yellowstone river. The red-throat seldom breaks water when hooked, but puts up a vigorous fight beneath the surface. As the streams are usually swift and rocky

and fringed with willows and alders, the angler must be wide awake to land his fish and save his tackle. In Yellowstone Lake it is infested with the white pelican parasite, rendering many of them emaciated and lacking in game qualities; those in the river, however, are well-nourished and gamy.

THE STEEL-HEAD TROUT. *(Salmo Gairdneri).*

The steel-head, or salmon trout, is the trimmest and most graceful, and the gamiest of all the trout species, being more salmon-like in shape and appearance. Its spots are smaller than in the other black-spotted species. It has, usually, a pink flush along the lateral line, but not so pronounced as in the rainbow trout. Its color is of a lighter hue than the red-throat or rainbow, with steely reflections.

During the past five years the United States Fish Commission has introduced the steel-head in the waters of Montana, which seem to be very suitable for this fine fish. I have seen quite a number of three-year-old steel-heads taken on the fly that weighed from two to three pounds, and in some localities they have grown still larger in deeper waters, which proves that they have come to stay. Each spring we now take thousands of eggs from fish that run up our waste water ditch from the creek where we planted them five years ago.

The steel-head trout surpasses all other trout for gameness and excellence of flavor, and rises eagerly to the artificial fly. It breaks water repeatedly when hooked, like the black bass, and is very trying to light tackle.

THE RAINBOW TROUT. *(Salmo irideus).*

The rainbow trout was introduced by the United States Fish Commission in the Firehole, or perhaps the Gibbon river, in the Yellowstone Park, from whence it sometimes descends to the Madison river in Montana, and may in time reach the Gallatin and Jefferson rivers. They have since been planted in other waters in Idaho and Montana, where they have done well, some coming under my notice weighing two pounds at two years old. The rainbow is similar in appearance to the red-throat, though somewhat deeper, perhaps, and with a shorter head and smaller mouth. Its distinguishing feature, however, is the broad red

band along the lateral line, common to both male and female. It is a handsome fish with rather more gameness than the red-throat trout, but not so vigorous on the rod as the steel-head trout of the same size. It grows to a larger size than the red-throat, but not so large as the steel-head.

THE GRAYLING. *(Thymallus montanus).*

Her Ladyship, the grayling, is as trim and graceful and withal as beautiful as a damsel dressed for her first ball. Her lovely iridescent colors and tall gaily-decorated dorsal fin, which might be compared to a graceful waving plume, must be seen fresh from the water to be properly appreciated. The grayling is not only a clean and handsome fish, but is as game as a trout and much better for the table. The grayling was taken in the Jefferson river a century ago by Lewis and Clark, and though they gave a fair description of it in the history of their expedition it remained unidentified until it became my good fortune a few years ago to recognize it as the grayling from the description of Captain Lewis.

While the grayling is found in the three forks of the Missouri, the Jefferson, Madison and Gallatin rivers, and in some tributaries lower down the stream and above the Great Falls, its ideal home is in the upper reaches of the Madison and Jefferson. The upper canyon of the Madison and its basin west of the Yellowstone Park is especially adapted to the grayling. There the water is swift, but unbroken, the bottom being composed of dark obsidian sand. In this region grayling of two pounds are not uncommon. The United States Fish Commission has been very successful in propagating the grayling at the Bozeman, Montana, station, and numerous waters have been stocked with this desirable game and food fish. About two million fry have been planted each season for several years in the streams contiguous to the grayling auxiliary station at Red Rock Lake at the head of the Jefferson, with the result of swarms of one, two and three year old fish. Grayling are so plentiful there that the trap can be opened for only a short time when taking spawners, otherwise they would enter in such numbers as to threaten them with suffocation.

As several million eggs have been shipped to eastern stations

by the United States Fish Commission, it is to be hoped that this incomparable fish will find suitable habitations in eastern streams to delight the angler with its beauty and gameness. It rises to the fly eagerly and is as game as the trout.

DISCUSSION OF DR. HENSHALL'S PAPER.

Mr. Peabody: Dr. Henshall's paper that was read just before the noon adjournment has had no discussion at all, and there are two points I would like to have considered. Two fish are named there, the grayling and the steelhead trout that he speaks of most enthusiastically. He says that the steel head trout is the gamiest and best of the trout species of which he knows, and especially in the Rocky Mountains, and he also refers to the productivity of the grayling, and says that they are plentiful and fill the streams out there. I would like to ask some of these Michigan men who know about the grayling, if they have stopped raising grayling, and also what the experience of any other fish culturist is regarding the steelhead trout. It seems to me if they are all that the doctor claims there, and are so easily reared and got from the hatchery in Montana, that they ought to be distributed and ought to be put into Michigan and Wisconsin waters especially. The commission gave us a quantity of eggs which we hatched and put in the northern waters of Wisconsin very successfully.

Mr. Clark: I can state that the United States Fish Commission is distributing the Montana grayling in Michigan although we don't know as yet what the result is, for I do not think that any have been taken, and unless a scientific examination is made it would be difficult to tell whether they are Montana or Michigan grayling. We are planting them so far only in the principal streams that formerly contained grayling, such as the AuSable River and Pere Marquette or branches, and unless otherwise ordered by the Commission I shall continue to do so until we see some results from those streams. They are a fine fish, and we have successfully raised them at Northville. There were on exhibition at Buffalo last season some two year old Montana grayling that had been reared at Northville, and I think every one who saw them will say that they were very nice fish, and from my observation of them at that age I do not see any

difference between them and the Michigan grayling. At earlier stages in their life, the first ones that we hatched, I doubted very much if they were grayling, although I do not know whether I corresponded with Washington in regard to the matter or not, but I think I spoke to Mr. Ravenel on the subject, saying that I thought the doctor had crossed them with trout, they were so spotted. Michigan grayling have no trout markings, but the Montana grayling have, and you can see them in Northville at the present time.

In regard to the steelhead trout, I will answer, so far as Michigan is concerned, that we have been planting them there for quite a while, and all those that have been caught are very large fish. One was sent to the Washington office this last winter which I think weighed seven pounds. There is one being mounted in Detroit that was caught near Traverse City that weighed twelve pounds, eight ounces; and there have been a number of other cases of this kind. The one that was forwarded to Washington I saw upon arrival. They seem to be caught in the great lake waters, or near-by, and my impression is that they are going to use Lakes Michigan, Huron and Superior, the same as they use the sea in their native country.

We have had remarkable success this year in the impregnation of the eggs, that is, getting a good quality, and I think that something like 90 per cent of good eggs were obtained from the fish, which we do not have from the rainbow trout.

Mr. Titcomb: You mean the domesticated fish?

A. Yes, sir.

Dr. Bean: I would like to say a word on Dr. Henshall's paper. The Montana grayling is not the same species as the Michigan grayling. It follows the usual rule among the graylings in that the very young have parr-marks. I do not know about the Michigan graylings. Mr. Clark has been in a much better position to learn than I, but speaking now as an ichthyologist and from book knowledge chiefly, I say that the young grayling ought to have parrmarks; the Montana grayling has them, the European species has them; the Montana grayling has a very much smaller fin than the Michigan grayling; its dorsal fin is shorter and lower; its head is smaller, and in other ways it is very easily distinguished from the Michigan grayling, so that

there will be no serious difficulty in future years if the fish establishes itself in Michigan, as I hope it will, in its being identified without any difficulty, when compared with the native species.

As to the steelhead trout (for it is a trout rather than a salmon) it is a spring spawner, and care ought to be taken in the introduction of the fish. I need scarcely remind fish commissioners of that fact, but I think it is liable to be overlooked in some circumstances. It is a fish more adapted to large bodies of water than to smaller streams. If it can find its way to the great lakes or to the ocean it will grow very large—even to thirty pounds. You know a fish that will approximate thirty pounds or even fifteen pounds, is a pretty dangerous customer to have associated with brook trout and other small species, because it is a great feeder and feeds at the time the brook trout are spawning. I merely mention these facts, because I think they ought to be kept in mind in the distribution of the fish.

The President: In distribution you would distribute them in lakes rather than in streams?

Dr. Bean: Yes, sir. They run up in the streams to spawn, but prefer to live in the great bodies of water where there is plenty of food and where they can have sea room.

There was a dispute for many years about the relation of the steelhead trout to the rainbow trout, this dispute was upheld on one side by my friend Dr. Jordan and on the other side by myself and I could not quite understand why there seemed to be so much difficulty on the part of the Pacific coast ichthyologist in recognizing the difference between the steelhead and the rainbow trout. There was no trouble in my mind about it; but I learned, much to my astonishment, a few years later that they had never seen a steelhead; the fish they called the steelhead was simply the sea-run rainbow. When the steelhead at last was found it was described as a new fish.

Mr. Clark: I hate to come up against scientists like Dr. Bean on this question, for I am not able to get down to the 1-1,000 part of a pound, as the scientists are, on these things, but the Michigan grayling, as hatched by myself in 1876, and again in 1880 or 1881, certainly did not bear the parr-marks. There is another distinguishing feature or difference in the two graylings, which anybody that remembers the Michigan gray-

ling knows. The Montana grayling hatches out and lies on the bottom, while the Michigan grayling pops out of the shell and swims like a whitefish. That is a difference that anybody will recognize; while the parr-mark is not visible on the Michigan grayling at any time.

Dr. Bean: That simply illustrates what I had in mind. I have been studying the young grayling chiefly from the books, and Mr. Clark has had the better opportunity of studying it in the field. That is where I go when I can, but when I cannot I am limited to books. The books all say that the young grayling ought to have parr-marks; the books also say that a male whitefish in the breeding season ought to have tubercles on the scales, sometimes it has and sometimes it has not. As a matter of fact, we do not know nearly all that is to be known about fish—even the wisest of us. There is a great deal more to be learned and it is to be learned from the fish themselves and not from books.

Mr. Titcomb: I was going to bring up a point which the doctor has brought up about the steelhead trout, and I think it should be emphasized as much as possible, and that is, as to the danger of introducing them into waters where you have the common trout. I should be inclined to treat them as just about as dangerous as the black bass to introduce in trout water. They are all right for our larger lakes, but I should be cautious about putting them into a lake with land-locked salmon even, but in any of our larger lakes with the lake trout it would be all right.

Dr. Birge: What do you mean by larger?

Mr. Titcomb: Not the great lakes necessarily. We have, for instance, a lake in Vermont six miles long where we are introducing steelhead trout very successfully, but that has nothing in it now but lake trout and small fish food. In Maine the commission has discontinued the distribution of steelhead trout, because almost all their waters which have not speckled trout have the land-locked salmon, which is valuable, and we cannot afford to lose them by the introduction of a new variety; and Mr. Peabody in considering that fish, should consider seriously where he puts it in Wisconsin.

The President: Would it do to put them in the same lakes with the bass, pickerel and that class of fish, armored fish?

Mr. Titcomb: That is a difficult question to answer. The

land-locked salmon will do well in some lakes with bass and pickerel, but in other lakes it is impossible to have them obtain a permanent foothold. I think the steelhead trout would stand a better show with the pickerel and bass than the land-locked salmon, if they have a wide range and the waters are varied in their nature. Take, for instance, some lakes which are peculiarly shaped, irregularly shaped, with many islands, and you will find the pickerel have their own part of that lake that they will be in most of the time, and one end of the lake where they spawn, and if the small-mouth bass are in the lake you may find them in still another portion of the lake, and it is possible with some of those lakes of irregular shape to introduce either the land-locked salmon or the steelhead trout quite successfully, especially if you have good streams for them to spawn in.

The President: They will have a Latin quarter and a Polish ward, will they? (Laughter).

Mr. Clark: Do you think the steelhead more of a cannibal than the rainbow?

Mr. Titcomb: Yes, they are more predacious and more voracious, because of their size.

Dr. Bean: In the West it is a toss-up between the steelhead and rainbow trout as to destructiveness of eggs; but the Dolly Varden is the most destructive consumer of salmon eggs in the waters.

Mr. Clark: I would like to ask Mr. Seagle this question: Do you find that the rainbow trout destroy the young trout?

Mr. Seagle: I do not. I have not observed more than half a dozen cases of cannibalism in my ponds since I have been having rainbow trout, covering a period of twenty years.

Mr. Clark: Do you think they will eat fish if they can get other food?

Mr. Dean: Rainbow trout will eat each other if they can, and we have to sort them, but not as much as the speckled trout.

Mr. Seagle: We keep our trout well sorted as to sizes, and possibly that is the reason we have no cannibalism. We sort our fish at least twice a year as to sizes.

Mr. C. E. Brewster, Grand Rapids: I would like to ask Mr.

Clark if rainbow trout are dangerous to the brook trout in the brook trout streams?

Mr. Clark: That is just the point. I think Mr. Dean will remember when he was with me at Northville that we had more rainbow trout than we have now, and possibly he was there at the time the experiment was tried of putting some large rainbow trout in a tank with smaller trout, and some large brook trout later on with smaller trout. We performed such an experiment at Northville, and the large rainbow trout did not eat the smaller fish, after leaving them there four or five days or a week; but the brook trout cleaned out nearly all the smaller trout that were in the tank. I never in my life have seen a rainbow with another trout in its mouth, while, of course, we are seeing brook trout do that all the time. We take them by the tail and pull them out. Our commercial men have had the same experience.

Mr. Lane: Yes.

Mr. Clark: I have never seen the tail of a trout sticking out of a rainbow trout's mouth.

Dr. Birge: You will write him a certificate of good character?

Mr. Clark: I will so far as that is concerned. It does not seem to me that they are cannibalistic at all. But Mr. Dean says he has seen it right along.

Mr. Dean: My idea is that the water being warmer makes a difference. I know at Northville at one time we put 55,000 rainbow trout in not a very large pool, and after carrying them some time we counted out 53,000. That would show there was a very small loss, but if we leave much larger trout in the ponds with them they become cannibalistic.

Mr. Clark: I do not wish to carry the idea that they will not eat fish. Of course if you starve them to it they will do so.

Mr. Brewster: Not long ago a complaint was made that the rainbow trout in the little Manistee river (and this is the second season that they have begun taking fish from that river) were eating up the brook trout. The man who made the complaint was a gentleman who spends all his time on the river and runs a club house there. I replied to his letter expressing my doubt about the matter, and he stated that a gentleman connected with the Pere Marquette Railway Company had recently caught a

two and a half pound rainbow trout with a brook trout more than six inches long in his stomach. I still expressed a doubt about the matter, and when I was up there about three or four weeks ago he showed me a number of brook trout that were badly lacerated, which showed that they had been caught by some larger fish and had been chewed up in the efforts of the larger fish to turn their prey and take it down head first; and those fish I examined very carefully, and they certainly looked to me to have been exactly as he stated: caught by some larger fish.

Mr. Titcomb: I have heard it said that the rainbow trout was responsible for the disappearance of the grayling in the Au-Sable river.

Mr. Clark: That is not the case.

Mr. Titcomb: I do not know but what I was misled in answering a question about the comparative voraciousness of rainbow and steelhead trout. I am not prepaerd to say that a rainbow trout would do as much damage as a steelhead of the same size. I had one experience with the two fish together of the same size in an aquarium four feet by two by eighteen to twenty inches high. These fish would weigh about a pound apiece. We had three or four rainbows, three or four speckled trout and one steelhead. We had to remove all the fish except the steelhead to save their lives—the steelhead was chasing them all over the aquarium and tried to drive them out of the water: he gave them no rest no matter whether they were speckled trout or rainbows.

Mr. Clark: Right in the Detroit hatchery I have in the aquaria rainbow and steelhead trout; I have seen the steelheads fight almost continuously during the spawning season, but I never saw them take down in their throat or undertake to swallow their antagonists, but they will fight viciously during that period. Was not this at the spawning season?

Mr. Titcomb: No, it was not. We have the same trouble with the rainbow trout during the spawning season.

Mr. Clark: Yes, but I have never seen them undertake to eat other fish.

Mr. Brewster: I would like to furnish Mr. Clark a brook trout from the Little Manistee that shows the marks that I have

described, and would like to have him examine it and pass judgment on it.

Mr. Clark: I do not think I could tell the markings of a rainbow trout's teeth. It may have been captured by some larger fish and chewed up.

Mr. Brewster: They think it is the rainbow and I think it is, too.

Mr. Clark: Show me a rainbow trout with a brook trout in its mouth, and I will be convinced.

Mr. Brewster: I did not see that.

Dr. Bean: I have had some experience with rainbow trout both in ponds and in the aquarium; and it is very well known on Long Island that the rainbow trout is the most voracious fellow in the ponds. One bully, (and not necessarily the largest fish) will boss the whole pond or tank, and he will drive every fish away or kill them, frequently, unless they are taken away. We had that trouble in the New York aquarium. We put in some of the fine rainbows from the Long Island hatchery, obtained from the United States Commission, and they were all alike. They would fight outrageously outside of the spawning season—any time seemed to be scrapping time with them—and there was no way of keeping them alive except by taking out of the tank the fighters, and we would have to take out a new one about every day.

Mr. A. L. Coulter: I would like to ask Mr. Clark one question: I am not a fish culturist; I do not study half as closely the habits of fish as I do the habits of the violaters of the game laws of Michigan. But I find that conditions in certain portions of the country change very materially. I think Mr. Clark will agree with me that the AuSable River at one time was a grayling stream; later in its history it was a speckled trout stream; after the speckled trout was introduced the rainbow was introduced.

Mr. Clark: The rainbow trout were introduced first in the AuSable river.

Mr. Coulter: Then take the Boardman river: the facts are that wherever rainbow trout are put in different streams the speckled trout disappear and the rainbow trout predominate. You could not convince a native on those streams in a hundred years, or by all the books and technical knowledge on earth, that

the rainbow trout were not destroying the speckled trout in the Michigan waters.

The President: Was the grayling driven out by another planting?

Mr. Coulter: The theory of the average mortal along those streams, who has lived all his life there and watched the disappearance of the native graylings, is that the speckled trout have destroyed the grayling, and in turn the rainbow trout is destroying the speckled trout, and you cannot convince him of anything else. I think at one time the Boardman river had some grayling in it; it was at first a native grayling stream, and the grayling was afterward replaced with speckled trout, and today you will catch about half and half, but the speckled trout are disappearing every year.

The President: I have been told by your Michigan fishermen that the grayling was a fish you could fish out more easily than you could trout; that you could go to a pool and catch every one of them; that is, they did not appear to be affected and get shy as others do, by the disappearance of their mates, but you could take the last grayling out of the pool and he would bite as eagerly as though he had not lost any of his companions.

Mr. Clark: I think that is true.

Mr. G. W. M. Brown, of Michigan: I went into the wilderness of Michigan early in 1869 and 1870 on the Pere Marquette, Baldwin Creek and Percy rivers particularly. On the first day of May, 1892, myself and a friend caught 163 grayling in one pool in the Manistee river in eighteen mile bay. That is the last day that I ever had fine fishing for grayling. The policy of the Michigan Fish Commission for the last two years has been in planting rainbow trout to put them in the larger streams where the water gets too warm for brook trout—in the Pere Marquette and the AuSable, but we do not furnish any rainbow trout for the smaller brook trout streams. For ten years I have been engaged in raising brook trout on a private, protected stream, as fine a stream as I ever saw, and the rainbow trout do not run in that stream at all; but right at the mouth of the stream last June I caught four rainbow trout that weighed eight and one-half pounds, although not a rainbow trout has been caught in that stream in the last ten years weighing a quarter of a pound. It is

a comparatively small stream and cold all the time; they do not run out of the larger rivers into the smaller streams

Mr. Clark: I did not bring up this subject to defend the rainbow trout for a moment, because it is immaterial to me which fish we have. I like the brook trout personally just as well as I do the rainbow trout. The part I wished to bring out was this: I wanted to know positively whether rainbow trout fed upon other trout. Now, Mr. Brewster has spoken of the AuSable river. The records show that the rainbow trout were the first ever planted in this stream, and old Uncle Dan Fitz Hugh was the man who put them there; and everybody knows what he had to say about the grayling and what he knew about it. This latter fish was plentiful there before the brook trout came, but they never have been so numerous as the brook trout now are, and I do not believe they ever will be, right in the AuSable river. If anybody can demonstrate to me that the rainbow trout fishing is better between two or three miles above Steven's bridge and down below Wickley's bridge than it was ten years ago, I would like to know it. Mr. Dickerson doesn't find it so—as he told me. They do not get any large rainbow trout above Wakley's bridge, except in spawning season but catch them in deep water. I have seen the rainbow trout up that river in March when you wardens are not there, and have seen a five-pound rainbow trout five miles above Steven's bridge; those large fish have been caught clear to the up dam during the spawning period. When we were hauling seines and catching brook trout for propagating purposes, we captured nearly as many rainbow trout fry as we did brook trout fry; but the large fish drop down in the deeper water where you do not get any brook trout.

Mr. Brewster: I think in 1891 the first rainbow trout was taken on the Bourdman river by Winnie of Traverse City. The river at that time was pretty well stocked with native grayling, and there were some native brook trout in the stream. It had been stocked heavily with brook trout, and from that time until 1895 or 1896 the brook trout fishing was good. Now more than 50 per cent of the trout taken from that river are the rainbow trout and the brook trout are gone or are becoming scarce. There are no grayling there at this time. I do not agree with my friend

Coulter that the brook trout have destroyed them; I think other elements have conspired to destroy them.

Mr. Coulter: I did not say that at all.

Mr. Brewster: Take the Manistee river up above the log chutes, the scene of the operations of the lumbermen, and you still find grayling and sometimes pretty good fishing. I know of a party of three who caught over 100 grayling there last year. Last year at my request Mr. Clark delivered half a dozen grayling to a friend of mine in Potoskey. Those grayling have been kept and are there now. I think he lost one out of a half dozen; they are being kept in water pumped from the bay. They are doing splendidly and growing nicely, and I believe that water up there is good for the grayling.

THE ROLE OF THE LARGER AQUATIC PLANTS IN THE BIOLOGY OF FRESH WATER.

BY RAYMOND H. POND, PH. D.

The primary object of an investigation of the biology of our Great Lakes, is to ascertain the factors which determine the quantity of food fish produced. The problems at once involved in such an undertaking are numerous, but may be in a general way, assigned to three groups. In the first group we may include those arising from the various relations which the different animals sustain to each other, such as, food and feeder, enemy and friend, host and parasite, and the like, all of which are strictly animal problems to be solved by the Zoologist. In a second group, would occur such questions as are suggested by the relations existing between animals and plants, and to these, the botanists as well as the zoologists may properly give attention. In the third group, we could include inquiries concerning the relation of plants to the soil and water, and such as belong more especially to the plant physiologist. Such a grouping of the secondary problems is purely arbitrary, being given to indicate the scope of the investigation, and to lead up to the statement already emphasized by Reighard and Ward, that a knowledge of the sources of nutrition of our food fishes, involves by necessity, an exhaustive study of the cycle of matter in the lakes.

There are two ultimate sources of food for the fish, namely; soil and air. Neither the fish, nor the animals upon which they feed, can secure nourishment from these sources directly. Plants must intervene to organize the mineral salts and carbon dioxide into food for the animals. In the case of the plant plankton, we have a large amount of organic matter that may be considered as food available for animals, which themselves in turn are either directly or indrectly used as food by the fish. Thus there occurs in the lake, a manufacturing of mineral salts and carbon dioxide into plant plankton, and also, a manufacturing of plant plankton indirectly into fish. It is thus evident, that each season's catch of fish means a withdrawal of so much organic matter from

the lake, and the sources of renewal of this organic matter, are manifestly important. It has long been known that water plants contain several essential food elements in greater proportion than the water, and we may say that aquatic plants concentrate within themselves nitrogen, potash, phosphoric acid. In the case of the plankton these elements must come from the water and then the plants die and are returned to solution. However, with the larger attached plants, we have another possibility, that is, they may take their mineral food from the substratum, and if they do, we have in them, agents active in the transfer of mineral food from the soil to the water. On the other hand, if the attached plants do not absorb nourishment from the soil, they must take it from the water, and their influence in this case would be to withhold during all the growing season, matter that would otherwise be available to the plant plankton.

The statement is common in all our text books of botany, even those published during the present year, that aquatic plants derive their nourishment from the water and not from the soil, that the roots are not organs of absorption as in land plants, but only holdfasts to anchor the plant. A review of the literature of this subject, shows that this statement is based upon argument and not experimental data. The anatomy of water plants has received quite a little attention in the past, and many authors have noted that the tissue systems for the conduction of water, which in land plants are so well developed, are in aquatic plants very rudimentary. Moreover, it has been observed that submerged aquatics have no evaporating surface and hence there is no necessity for an upward current in the plant. Again, the entire surface of submerged plants is permeable to water and the plant may easily secure its mineral food directly from the surrounding water. Such has been the majority opinion and argument up to the present time; but investigation now completed though as yet unpublished, proves beyond a doubt, I think, that most of our common aquatic plants are absolutely dependent upon being rooted in the soil for optimum growth, and few of them indeed can survive the growing season, if denied attachment to the soil.

To consider now some of the evidence for the latter opinion. Suppose we construct some large boxes and build a raft around

the top of them so that they will float about level with the surface of the lake or slightly submerged. In some of these boxes we will make a deposit of soil six inches or more deep. This soil is to be taken from the lake bottom in some locality where there is an abundant growth of plants. In this we will plant a certain number of individuals of uniform size, of some one species that have been carefully selected from specimens growing in the lake. In the other box we will attach a like number of such plants to wooden bars, and fasten these bars so that the plants in the two boxes are in the same depth of water. We thus have for comparison, two groups of plants, one of which is surrounded by natural conditions, and the other has natural conditions except that the soil is absent, and the plants can get only such nourishment as is provided by the water. After a period of four weeks very marked differences between the two groups of plants may be noted. The plants rooted in soil look as strong and healthy as those growing in the lake. The volume of vegetation produced by the former group was twice that produced by the latter group, while the suspended plants were stunted in growth and manifested the ordinary signs of unfavorable environment. If we now collect our two groups of plants, and after carefully washing, obtain the dry weight, it will be found to be a third more for the plants rooted in soil. It is thus evident, that soil is necessary for the best growth of these plants. If now we compare equal volumes of the fresh plants in our experiment, it will appear that the dry weight of the suspended plants is greater than that of those rooted in soil. This must mean that different physiological processes have been operating in the two groups. If a microscopic examination of the fresh plants be made, it will be found that the tissues of the plants rooted in soil contain relatively little starch, while those of the suspended plants are literally gorged with starch. Thus is explained our discovery concerning the dry weight of equal volumes. It is the abnormal increase in the amount of starch, that makes the suspended plants weigh more. If now we compare the two groups with regard to their chemical composition, we shall find that the plants which were denied the soil, contain a smaller proportion of nitrogen, of potash, and of phosphoric acid. To recall now the results of this line of investigation, we may say that when the plants are

not allowed to root in the soil, and are limited to the lake water for nourishment, an abnormal growth results, which is manifested by diminished volume of vegetation and total dry weight; also, by an excess of starch, and deficiency of nitrogen, potash and phosphoric acid.

Considering now the question, are the roots merely organs of attachment, or are they also for the purpose of absorption? It is not a difficult matter to separate the roots of a plant from the stem, so that solutions differing in chemical composition, may be offered to each at the same time. In this way lithium nitrate may be offered to the roots, so that the lithium, if found later by spectroscopic examination in the upper parts of the plant, may be positively known to have been absorbed by the roots and conducted upward into the stem. It is also possible to construct an apparatus by which the amount of water absorbed by a root in a given time can be measured. Both of these methods have been employed, and there can be no doubt but that the roots are organs of absorption. Moreover, the roots of most of our common aquatics develop structures, the presence of which is almost *prima facie* evidence that the organs bearing them are for absorption. These structures are the so-called root hairs, and they occur on all of our terrestrial plants, with a few exceptions. Examination has now shown that they are common also on the roots of aquatic plants. These hairs are simply ordinary root cells which are protected from the outer cell layer of the root, for the purpose of securing the maximum absorbing surface with the least expenditure of tissue.

We may next enquire, what quality of soil is best suited to support a good plant growth? Last summer here at the Hatchery, three soils were tested. One was a loam from Squaw harbor like ordinary garden soil, another was sandy with plant remains scattered through it, and the third was clayey. The same species was grown at the same time in each soil under otherwise natural conditions. The poorest growth occurred on the clay, the second best on the sandy soil, and the best on the loam. Thus is confirmed experimentally the observation made from the study of all the plant beds in the region of these islands, that other conditions being favorable, the most abundant growth of aquatic plants occurs on what would be called a good truck soil. Many

of the species will maintain a growth on any of these soils and continue to reproduce each season, but it is only on the good loamy soil that the dense aquatic meadows occur.

From a study of such meadows, some of the functions hitherto assigned to aquatic plants have been established, such as protection to animals seeking refuge, a base of attachment for the growth of Algae, and even as direct food for some animals. It is in protected caves little disturbed by wave action that such meadows occur, and the aeration of the water is an important duty of the plants here. During the daytime all green plants give off oxygen as a waste of product in the manufacture of starch, and an excellent idea of what this amounts to may be obtained by observing the almost constant stream of bubbles that rise from the plants on a bright day. But perhaps the most important part played by the larger aquatic plants is the one only recently established, that of contributing to the plankton food supply. One author has recently stated that there is a direct relation between the quantity of plankton and the proportion of nitrates in the water. During each season by the changing winds and currents a large amount of plant debris is carried out into the lake from the aquatic meadows, where during the period of its slow oxidation, it is available as food for the animal plankton and when oxidized, the mineral salts taken from the soil are contributed to the water to be used by the plant plankton in organizing more animal food. It is thus apparent that in the economy of nature, water plants have the same part to play with respect to organisms of a higher order, as the terrestrial plants; that is, they are the organizers of inorganic matter for the benefit of the higher organisms dependent upon their activity.

It is quite probable that the waters poor in plankton will be found to have a small growth of the attached aquatics. Certain it is, at least, that in any explanation to account for a scarcity of plankton in a given water, the relative abundance of the aquatic plants would necessarily be considered.

Some species are much more dependent upon the soil than others. Chara and Myriophyllum are not as dependent as Vallisneria and Potamogeton perfoliatus. The two latter plants would be excellent to plant in fish ponds, because they are so

dependent upon the soil and because they develop a large volume of vegetation during the growing season.

To recapitulate, we have first the facts hitherto known, that the larger aquatics are important as furnishers of shelter, as aerating agents, as a base of attachment for the growth of Algae and as direct food for some animals. Second, the fact first established in this paper, that these plants are important agents, through which the soil is made to contribute a goodly share to the food supply of the lake.

DISCUSSION OF DR. POND'S PAPER.

Dr. Birge: Was the experiment tried of raising these plants in boxes with earth and water, but with the roots removed? In the experiment described there was only one arrangement given —plants with roots and earth and plants without roots,—and with the ordinary lake water, of course. If 6 inches of earth had been placed in this box, it seems to me that a good deal of mineral salt might leach out of the earth, which the plants might have absorbed through the leaves; and I would ask, was that experiment tried, to see the difference.

Prof. Ward: I was only an observer of the experiment, but it is evident that in one respect, at least, the statement of the author has not been clearly understood. The roots were not removed from the plants, but the latter were very carefully selected, so that there should be no chance of any kind of bruising or breaking of the tissue to afford the slightest ground for supposing they were not in perfect physiological condition. The experiments were also tried in water so comparatively shallow that while there might have been a difference under the conditions which Dr. Birge mentions, I should rather imagine that there would not be. So far as I know, the exact experiment which he indicates of placing earth in the box but not in contact with the roots of the plant, was not tried. It, however, may have been, for Dr. Pond experimented very extensively and there were many experiments made of which he gave no definite report.

Mr. J. J. Stranahan, of Georgia: If the plant myriophyllum were used in a pond with poor soil and pure soft water, what would the result be?

Prof. Ward: I wish Dr. Pond were here. He experimented

three or four years on this matter and he has really found some things of very great value, and I deeply regret that he cannot be here to answer such questions himself.

Dr. Birge: Have you tried it yourself?

Mr. Stranahan: Yes, but our myriophyllum does not thrive. Our soil and water is not conducive to any kind of vegetable growth.

Mr. F. N. Clark, Northville, Mich.: We frequently meet this same difficulty at our meetings, the author of the paper not being present and these questions coming up that no one can answer. I think it would be well if the Secretary would note those points and ask the author of this paper to present something on that line and perhaps others, as an addition to his paper by way of discussion.

Dr. Birge: Why not have him answer any of these questions and have them printed.

Mr. Clark: That would be well, but we always have papers where the authors are not present and most always questions come up that no one can answer.

The President: Dr. Pond might add his answers to these questions as a part of the discussion. I believe that is practicable.

Mr. Titcomb: I suggest that Mr. Stranahan relate the results of his experiments under his peculiar conditions.

Mr. Stranahan: We have made a good many experiments; we have tried all sorts of fertilizers, we have tried a compost made with cotton seed meal and with barnyard manure, and we have succeeded in making our myriophyllum and other plants grow well the first year, but they almost always die out and become absent the second year.

Dr. Birge: Even if you continue the manuring?

Mr. Stranahan: We have not continued it, because it is impossible to do it in a pond full of fish. We have also had considerable correspondence with rice planters along the coast, and find that they have never found a fertilizer which is practicable for rice which is to be flooded, which is discouraging, because vegetation is of very great importance as shown by the success had by Leary at San Marcos. But there the soil was very rich and black; the myriophyllum growing from the bottom of the

pond to the top in one dense mass, in 6 or 7 feet of water; and there are more black bass produced there than at any other station of the United States Fish Commission—90,000 to 100,000 in one year.

Mr. Dwight Lydell, of Mill Creek, Mich.: I have found that the chara weed is better for pond fish than the potamogeton, as stated in the paper.

Mr. Clark: We have threshed this over each year and been in the same position ever since I have been a member of the association. At Wood's Hole we passed a resolution that all papers to be read by those in attendance should first be presented, that the papers by persons not present should be offered, and then be read as decided by the association. That resolution grew out of this very discussion that we are now in, and on your minutes of the proceedings at Wood's Hole you will find a resolution that no paper shall be read before this Society unless the author is there to read it, except by special resolution.

I wish to correct one statement of Mr. Stranahan's, where he spoke regarding the product of black bass. I do this out of respect for the superintendent of the bass hatchery at Mill Creek. The Mill Creek hatchery last year turned out over 1,000,000 bass.

Mr. Lydell: About 50,000 of those were fingerlings.

Mr. Titcomb: I hope no one here will refrain from asking any question that comes up in connection with this paper. I think if Mr. Pond is going to make an addendum to his paper for publication, he should have our views, and read our questions. It is a very important matter.

Mr. Clark: I have no objection. I simply state the resolution passed at Wood's Hole.

A SUCCESSFUL YEAR IN THE ARTIFICIAL PROPAGATION OF THE WHITEFISH.

BY FRANK N. CLARK.

As such unusual success has attended the efforts in the handling of whitefish during the past season, it is deemed that a few brief notes relative thereto would not be amiss.

The whitefish egg taking of the season just closed has been the most successful in Michigan, in the history of the United States Fish Commission. Not only has the quantity taken greatly exceeded that of any previous year, but also the quality has far surpassed that of any of the earlier efforts. This may be owing perhaps, in part, to the favorable weather conditions, improved facilities, and expert manipulation, but in the main it goes to show the wonderful results of the plants which have been made in the past in the waters of the Great Lakes.

In the collection and hatching of whitefish at the present time, two very important essentials are those of funds for carrying on the work, and then of obtaining the fish. With these two problems solved, the production of fry may be unlimited, and perhaps it might be well to state right here that of the above two mentioned factors, the former is a far more insurmountable barrier than the latter.

In the early days of the work, back in the seventies, the first successful take of whitefish eggs, with perhaps the exception of a few obtained on the Detroit River by Mr. Seth Green and my father, was made not three miles from where we are now holding this meeting. The quantity at that time, was limited to the amount obtained from the ripe fish which were found in the nets from day to day. This plan was continued for a number of years until it was discovered by experiment, that whitefish could be held in crates and pounds until ripe, thereby greatly increasing the production. This work of penning has been carried on quite extensively and with every success, on the Detroit River and at Monroe Piers, at the mouth of the Raisin River, Lake Erie.

It seems as though a no more forcible illustration of the gratifying results of the whitefish operations can be given than that of a comparison between the work of the past season and of 1896, but five years before. There was practically no difference in the methods employed, and the grounds operated were the same. In 1896 the total number of fish caught on the Detroit River was 11,263, while during the season recently completed 41,242 were taken, not far from four times the number obtained but five years previous under almost identical conditions.

Not only on the Detroit River, which is perhaps the best point on the Great Lakes for the collection of whitefish eggs, has the work been so highly successful, but at all other places where an attempt has been made the results have been the same. It is certain that the season of 1901 has been by far the best on the Great Lakes, and the records of both the United States and Canadian governments have never been equaled by the unprecedented take of upwards of 800,000,000 eggs. This large take resulted in the filling of every hatchery on the Lakes to its utmost capacity, and at one time it was thought necessary to plant a portion of the eggs on the spawning grounds. Later, however, this obstacle was overcome by holding part on trays for a short time. More auxiliary stations adjacent to the spawning grounds should be provided for the handling of the great surplus. This would do away largely with the necessity of transporting the fry for such long distances, which is not only very expensive, but at times rather detrimental to their condition. These auxiliary hatcheries will, no doubt, be provided for in the near future by the United States government.

The following account may perhaps give a fair idea of some of the details of the Detroit River work.

The collection of eggs was made from the field stations on Belle Isle and Grassy Island, the former being located in the Detriot River opposite the upper end of Detroit, and the latter about eight miles down the river below the city. The first fishing was done on the 16th of October and the work was continued until December 3rd. During this time, 2,875 hauls of the seine were made and 41,242 fish captured, an average of between fourteen and fifteen per haul, this latter being much better than usual.

Of these, 2,270 were undersized (weighing less than two pounds) and were immediately returned to the river, thus making 38,972 the number retained. They were held in crates and pounds, the former being made about twelve feet long, four feet wide, and five feet deep, of slats in order to allow free circulation of water, and the latter were of irregular size and shape, and built by driving boards into the bottom with a space between each one for free passage of water. The best day's fishing was on November 18th, when 2,568 fish were caught, and the best day's egg-taking was on November 29th, when 52,920,000 eggs were obtained. Of the fish held, 22,245 were males, and 16,727 females, and of the latter, 12,529 were stripped, the remainder being spent, plugged, or hard when operations ceased. The egg taking period extended from November 10th to December 11th, inclusive, during which time 366,040,000 eggs were forwarded to the Detroit Hatchery, thus making the average number per fish 29,215.

The number of eggs shipped to various points was 201,800,000, leaving 164,240,000 in the hatchery. As the total hatch was 135,000,000, it would appear that the percentage was a trifle above 82, but in reality it is about 85, when allowance is made for the fact that a part of the eggs shipped were eyed. The season was rather earlier than usual, as the fish were hatched between March 23rd and April 16th. The distribution continued from March 30th to April 17th, and was made by means of a tug and the regular transportation cars. The latter took 27,000,000 fry in five loads, three of 5,000,000 each and two of 6,000,000 each, the former to Charlevoix and the latter to Mackinac City. The balance were deposited in the Detroit River and Lake St. Clair.

Again let me emphatically state that there has just been completed the greatest known year's work in the artificial propagation of the whitefish.

DISCUSSION OF MR. CLARK'S PAPER.

Before reading his paper Mr. Clark said: I wish to state in connection with this short paper, that our good Secretary wrote me, I think, early in January, asking me to prepare a paper—I think he said something about whitefish or something in relation to whitefish—and I wrote him that I did not believe I would

have time to give him anything and did not know that I had anything new. That was the last I heard of it until the notices came out, and I saw he had me down for a paper. So I give you these few notes. It is not a paper, but a few notes on our work in connection more particularly with the whitefish. I do not want you to think you are going to get a paper.

Secretary Peabody: It seemed perfectly safe to put you down on the subject of whitefish, as being the greatest expert on that subject in the country.

Mr. Clark: I do not think so. There are many other whitefish experts in the country besides F. N. Clark.

The President: Was not the season an especially propitious one?

Mr. Clark: The water was very good, but the experience of the United States Fish Commission on the Detroit river for the three seasons we have been operating since the Michigan Fish Commission turned it over to us, is that there has not been so very much difference in that respect. I think that when the Michigan Fish Commission operated they did have three or four exceptionally severe seasons, when ice made in the river, so they could not fish. We had no trouble of that kind, and I think we are safe in anticipating a take of 300,000,000 or 400,000,000 eggs this coming season. It all depends on the temperature of the water both with the fish and eggs. I do not think it was an exceptional season. I think it was simply because Lake Erie has more fish today than it ever had before. I think Mr. Downing or Mr. Fox will bear me out in this statement judging by their work at Monroe.

The President: It is borne out by the commercial reports also, I think.

Mr. Clark: Yes, sir.

Mr. Gunckel: I never saw line fishing so good as it is out off Monroe this season. I caught with a fly one whitefish weighing eighteen and one-half pounds.

Mr. Stranahan: I would like to ask Mr. Clark, do you think there are more whitefish in the lake than there ever was, away back in the early days of fishing?

Mr. Clark: I do not mean to be understood as saying that. I mean that the increased catch of whitefish in Lake Erie is

wholly due to the propagation and planting of fish in the Detroit river and Lake Erie. I say it boldly because there is less protection to the whitefish in Lake Erie and the Detroit river. So, if it is not from our work, what is it from? The catch has increased each year gradually from 12,000 until now we are expecting to take 50,000 fish this fall on the Detroit river.

The President: That is the testimony of all of the fishermen along our shores, that the depletion caused by the fine nets, etc., has been arrested.

Mr. S. W. Downing, of Put-in-Bay: I would like to bear Mr. Clark out in his last assertion, that the increase is undoubtedly due to the propagation of the fish. We have steadily increased in the number of eggs taken. Two years ago 235,000,000 eggs were taken at Put-in-Bay. Next season 194,000,000, last season 335,000,000 eggs were taken. That in connection with Mr. Clark's station would make the total something over 700,000,000; and there is no question but what it is coming from the artificial hatching of the fish. We put out from this station alone this spring a little over 200,000,000 fry. Our total hatch was 81.8 per cent. Mr. Clark beat me about 3 per cent on his hatch.

Mr. Clark: Another fact bears out the results of our work. They seldom used to catch any small fish—that is, what we call underweight fish, those under two pounds. A year ago last fall we caught a little over 6,000, and last season over 2,000. Now, ten or fifteen years previous to that, no mention was made of the small fish, there not being enough to attract attention.

Mr. Lydell: It has been about fourteen years since I commenced taking charge of some of the river work, and at that time we had between 250 and 300 jars in the Detroit hatchery, and ran seven fishing grounds to fill those jars with eggs; and now we have 1,035 jars and three fishing grounds are sufficient to fill them—and more too. Last year I think we also filled the Duluth house and the Soo house and all the houses of the United States Fish Commission, easily, with three grounds.

Dr. T. H. Bean: (Formerly of the United States Fish Commission, now of the World's Fair at St. Louis). It has seemed to me that there was a little skepticism about the remark by my friend Gunckel about whitefish being caught on a hook, and I

thought perhaps it would be interesting to state something that has occurred in my own experience in keeping whitefish in aquaria. There is a whitefish which you know has been called the Labrador whitefish, but which I cannot distinguish by any essential characters from the common whitefish of the great lakes. All the characteristics that have been assigned to them by ichthyological writers prove to be transitory or non-existent, and for that reason I still hold to the opinion expressed a few years ago, that the Labrador whitefish and the common whitefish are the same species.

Now, it has been supposed, I think very generally, that that form of whitefish with the small mouth and the lower jaw shorter than the upper will not take the hook and will not take live bait. In the aquarium of New York City in 1897 we had a lot of so-called Labrador whitefish from Canandaigua lake. They were fed upon small fresh water shrimp, which were shipped from Caledonia and other parts of the state. They fed very readily upon them, but after a time it was difficult to obtain that food, and then we began putting into the tanks small salt water minnows, or mummichogs (killifish), and in a very little while the Labrador whitefish were rising to them and taking them the same as the trout did, and they continued to feed on them for months at a time.

And another fact, in Canandaigua lake, fishermen catch those same whitefish on baited hooks.

I saw a little item in *Forest & Stream*, by a Canadian member of the Fishery Commission, to the effect that the new whitefish, which evidently is closely related to the common whitefish, and I think Dr. Smith has identified it as Richardson's whitefish, is known up there to take the hook, and is so caught. I say this in defense of my friend Commodore Gunckel, and as a matter of some interest, because I do not think it is generally known that the common whitefish will take the hook.

Mr. Clark: I believe that Dr. Gunckel thought I would not smile when he spoke of catching the eighteen pound whitefish with a fly. I want to say that whitefish weighing two and one-half or three pounds, which have been raised in our ponds, take flies from the top of the water.

The President: That is the natural fly that lights on the water?

Mr. Clark: Yes, sir.

Mr. Gunckel: In looking over my records I find I did not wear my glasses when I made my first statement. The fish that I actually caught at the mouth of the river Raisin was a common carp. (Laughter). But Judge Potter, for many years a fish commissioner of the state of Ohio, told me probably twenty times of the whitefish that he had caught off Nipegon—I have forgotten the bait that he used—and I know when I go to Crystal Lake in the northern part of Michigan, of some Indians who come from Frankfort to sell whitefish (and I believe there are more whitefish to the square foot in that lake than in any lake Mr. Clark has in Michigan), and they catch them with hook and line. They bring in fifteen or twenty whitefish nearly every summer that I go up there to fish. They must bite with hook and line. All the propagation that you talk about leans toward the commercial interests. About three-quarters of the gentlemen present represent the angling fraternity of which I am a proud member. I believe I belong to some fourteen different angling clubs and societies in the United States—always have and I am now growing old in the business and have the reputation of being the biggest liar in the United States, and so am entitled to recognition.

Mr. Titcomb: To substantiate Dr. Gunckel's remarks—

Mr. Gunckel: Don't get that "Doctor."

Mr. Titcomb: I want to say that in Lake Winnepiseogee the whitefish is commonly taken with hook and line; and in further substantiation of Dr. Gunckel's remark about this particular whitefish which weighed so much, he took me aside here today and told me about it, but explained that he not only had a baited hook, but had a bated breath. (Laughter).

Mr. W. A. Palmer, Buchanan, Mich.: I would like to ask Mr. Clark to what he attributes absence of whitefish about Michigan City, St. Joe and Grand Haven, where they used to be so plenty?

Mr. Clark: Fishermen. I think there have been without question millions upon millions of small fish caught in Lake Michigan and other lakes—not so many in Lake Erie, because

they cannot get them. In Lake Michigan however, there has been just as much fishing as in Lake Erie, while the former has not been anywhere near so heavily planted, therefore to furnish its quota many of the fish have been under weight. The fishermen being after every one they can get, regardless of its size, and consequently the fish are being greatly reduced in numbers in Lake Michigan. I think if we could plant fry in Lake Michigan as we are doing in Lake Erie and Detroit river, you would see in the course of five to fifteen years, a great increase in the Lake Michigan output. Lake Erie and the Detroit river have had at least one-half of all the fry that have been hatched on the great lakes.

Mr. Palmer: In other words, Lake Michigan and that vicinity have not had any fry there.

Mr. Clark: Oh, no, I do not say that. They have had quite a good plant every year. This year we put in Lake Michigan about 30,000,000, and I think very likely Wisconsin must have put in 20,000,000 or more.

The President: We did.

Mr. Clark: But 50,000,000 fry is not enough for Lake Michigan. We should have 500,000,000.

The President: I would like to ask, is the whitefish a migratory fish, or does he stay in the vicinity of his birth place, or where he is planted. Do they rove around and colonize other parts of the lake, or are they local?

Mr. Clark: I cannot answer that question. I have been connected with whitefish work for thirty years, and that is a question that I cannot answer you. Perhaps our scientific men can, but I cannot; however I can say that the whitefish are in the Detroit river in the fall and I know that they are not there in the spring, but whether they go a long distance or not I am unable to tell. We do not get, or we did not used to get, the same colored fish in Lake Huron that we do in Lake Erie and the Detroit river. I hardly think they ever go up through the St. Clair river into Lake Huron, but still I cannot answer those questions.

Mr. Palmer: A large quantity of whitefish were caught this season in the vicinity of Charlevoix, while at South Huron, formerly one of the best fishing grounds, there have not been any.

Mr. Clark: I can say in answer that for a term of years the United States Fish Commission have not planted any whitefish in Lake Michigan below Frankfort, and our reason for it is that we do not believe the whitefish spawn below that point. We do not know for certain, but are waiting for the Scientific Bureau to make investigation. The only way we have of knowing where whitefish spawn is by looking the fish over that are caught by the fishermen at such points, and I do not think there have ever been any eggs taken from south of a point near Frankfort across the lake. Years ago we used to send men to St. Joseph, Michigan City, and I think one year I had some men over on the other side near Waukegan; but we never were able to get any ripe fish there, and that is the only way we know as to whether or not they are spawning at that point. I think that after we have our scientists do some dredging and working on that line, they will be able to tell us. I believe I have stated that we do not know where the spawning grounds are. As long as we have taken eggs off Alpena, ever since 1880, we get ripe fish at certain points, but I am here to say that I do not know that that is the spawning ground, because there have never been any eggs taken up from the bottom.

Dr. Birge: That would indicate a very considerable distance of migration. Whitefish are caught all through the southern end of Lake Michigan and the schools must have migrated 80 or 100 miles there, if the fish did not spawn south of Frankfort.

Mr. Clark: I would not call 80 miles a great migration.

Dr. Birge: I would not think so either.

Mr. Clark: When we have this biological station some of these questions will be settled, and I do not expect to see this problem decided until a thorough investigation on that line is made and this is what the practical fish culturists on our great lakes are waiting for—something along that line—and our scientists must start it.

Prof. Reighard: I may, perhaps, throw a little light on the question of the existence of local races of whitefish: Last summer the United States Fish Commission sent a man to Lake Erie to study the local races of whitefish, and he worked at several places on Lake Erie, by the statistical method, making very accurate measurements and determinations of color of whitefish

in different regions, but was unable to find any local differences. Now, in the case of some of the marine fishes, those local differences are very noticeable, and by making such studies it is possible to locate local races. The whitefish spawn in the western end of the lake in the fall, and that would obliterate local races by interbreeding.

On the other hand, this same man, Dr. Raymond Pearl, has gone this year to the northern end of Lake Michigan and is at Charlevoix now. He has been measuring the whitefish there and he finds very distinct evidences that they form a different race. This race is very markedly different in its measurements from that of Lake Erie. Of course that is nothing more than the fishermen have said for many years, that they could tell Lake Erie whitefish from Lake Michigan whitefish, but so far as scientific evidence goes it is all there is, I think.

The President: Is there not a whitefish called a bluefish?

Mr. Clark: Yes, sir, but that is not the fish under discussion.

I would like to ask Prof. Reighard whether his investigator at Charlevoix has examined a sufficient number of specimens to know whether he may not have had some fish that were planted there and had increased in size.

Prof. Reighard: That was one of the things had in mind in sending him up there, but as far as I can learn he has no evidence on that point. It ought to be possible to find by this method trace of Lake Erie whitefish planted up there, but he has not got them yet. That may come out when he reaches the final discussion of his results.

Mr. Clark: This could lead into a great many questions we would like to ask, but I do not know as we ought to take up the time.

The President: It is a very interesting topic to us who are situated on the great lakes.

THE BROOK TROUT DISEASE AND CEMENT PONDS.

BY M. C. MARSH.

At the preceding meeting of this society, in some remarks on the brook trout disease, you may remember that it was pronounced to be probably bacterial, but that this had not been definitely established by the usual process applicable in such cases. Since that time experiments on healthy trout at Northville have furnished substantial proof of its bacterial nature. It is not necessary to go into these in detail here save to say that they consisted of a series of inoculations into healthy trout of pure cultures of bacteria taken from the blood of diseased trout. Such inoculated trout developed the same symptoms and lesions as those which had contracted the disease in the natural way, and like them, they died. The experiments were controlled by duplicate lots of healthy trout which were kept in the same water and fed the same food as the others, and under identical conditions save that they were not inoculated with the cultures. There was no loss among these latter trout. The bacterial organism used in these inoculations is now regarded as the cause of the brook trout disease.

Cement ponds were proposed as a rational method of preventing this trouble with the brook trout. It was held that the germs of disease menaced the trout in small ponds from two sources,—the immediate surroundings of the pond, and the water supply. Just what the relative importance of these two sources was could not be stated with certainty at that time, but there were reasonable grounds for believing that the former—the linings of the ponds and the earth about them—was the greater of the two, and that if this danger were removed that the disease might be prevented. The cement ponds were directed against the one source of infection alone—the localized or secondary source—and could not protect against any infection which might flow down with the water supply. There seemed to be a reasonable chance that danger from the water supply was not great enough to cause the epidemic every year, largely because the fry in the troughs had

seldom had the disease. Accordingly, two of these ponds were built last fall at the Northville Station of the United States Fish Commission. They had a foundation of concrete and a superficial layer of cement on sides and bottom, so that they were solid throughout and impervious. Nothing could enter these ponds through the construction itself, but must come by way of the water supply or directly from above. They were stocked with brook trout without suspicion of disease, some from the Au Sable River, secured by permission of the Michigan Fish Commission, the rest from the trout farm of Mr. Hansen, at Osceola, Wis.

We have now had nearly a year's experience with these ponds. They have failed to prevent the disease. Most of the trout thrived in a promising way until January, when they commenced to die. The dead had the suspicious marks or lesions of the disease and from the blood pure cultures were obtained of the same organism that had previously been found in the diseased trout, before the cement ponds were built. It is the same disease recurring. The Au Sable trout began to die very soon after they were placed in the cement ponds. Now, a large per cent of the Au Sable fish had sustained injuries chiefly of one sort, a bruised snout from contact with the crates in which they were temporarily held. The injured snout is an open door for the entrance of micro-organisms into the blood. The protecting skin is broken, the tissue beneath is left raw and a bacterium drifting against this exposed surface finds an easy lodgment and nourishment of exactly the sort adapted to it. It immediately begins to multiply and is carried into the circulation and finally brings about the death of the trout. The rule may be laid down then that trout with the skin intact have the best chance of resisting the initial attack and that those with wounds of any kind can be placed in infected waters only with fatal results. The other trout were uninjured fish and they resisted the disease for some months or until the organisms had time to make their way through more minute wounds which doubtless all fish receive in the natural course of their existence, or by way of the intestinal tract having been taken in when feeding; or they may possibly have penetrated slowly the unbroken tissues.

The cement ponds are, then, if this one year's trial is a reliable index, as it probably is, a failure as far as their main pur-

pose is concerned, prevention of this disease. They demonstrate this fact very clearly—that they are insufficient to deal with it as exemplified at the Northville Station, and in so doing they make a valuable contribution to knowledge of this disease, and an important step is taken in attempts at prevention. For the idea of excluding infection by an impervious construction followed naturally from the nature of the disease and was one of the very few practicable means of dealing with the problem. The ponds accomplished this exclusion, for they have withstood the severity of winter and are practically intact. They have protected the trout from infection contained in the earth about the pond and this being insufficient the conclusion is forced that the water itself brings into the pond the bacteria of disease and that the springs that supply the station are their source. That these bacteria arise in the springs is a matter of very serious import. It throws the origin of disease back to a source over which we have no control. It is impossible to disinfect these springs. Disinfection can occur only in the superficial layer of the bottom while fresh infection is constantly arising from the depths. The water cannot be filtered to a germ free condition on the necessary scale for practical operations. The infection cannot be dug out. It is a natural attribute of the supply springs and I do not see any means of dealing with it which allows brook trout culture on the present intensive plan, i. e., many fish in a small space, and at stations with infected water.

This does not compel the abandonment of the brook trout at such stations, however; at least, not as yet. The next thing to be recommended is culture in comparatively large natural ponds. The chief advantage gained is the increase of space, diluting the infection and separating the fish. The more natural conditions, aside from space, doubtless have their influence also. There is some past experience favorable enough to justify such a pond. Mr. R. S. Johnson of the United States Fish Commission has checked the disease in this way at his station at Manchester, Iowa. It may be considered a sort of compromise with the disease because even if continuously successful, it cannot be expected to produce as many trout to a given outlay of space as the small pond system. It cannot eradicate all the conditions that cause the disease, and it is possible, even probable, that with continued

use this large pond will lose such efficacy as it possesses. This is a matter for experience to settle. Some of the old ponds at Northville will probably be replaced by excavating a large basin which shall be fed with cold spring water and contain natural vegetation. It will be stocked with brook trout and the round of fish cultural operations which involves the use of ponds will be conducted in it. It is expected to reduce materially the losses from disease, but whether as a permanent system it will give satisfactory returns remains to be seen.

The question of the value of cement ponds as a construction for small ponds in general, aside from any question of disease, will I hope be tried out by the experience of the fish culturist. I think they have made a favorable impression at the outset and possibly continued use may show that their greater durability, cleanliness, and sightliness, will more than compensate their greater initial cost.

DISCUSSION OF MR. MARSH'S PAPER.

Dr. Birge: I should be glad if Prof. Marsh would say a little as to the nature of the organism he describes, as to whether it is a baccillus or a coccus.

Mr. Marsh: It appears as every form that a bacterium takes, and when one sees it under the microscope in the tissues it is plainly a bacillus; but when you isolate it on solid media outside of the fish it is plainly a coccus, and yet it is the same thing.

Dr. Birge: How is it in liquid media?

Mr. Marsh: It is intermediate, a short rod.

Q. Does it form spores?

A. No, it does not.

Q. Have you succeeded at all in finding it in the water?

A. That is what I have been attempting to learn during my last trip to Northville. I have been there about a week, but have not got it yet.

Q. Does it form a characteristic growth on plates?

A. Yes, it does. The colony resembles a number of other water organisms and is not so strongly characterized that you can readily tell it from these.

Q. Does it liquify?

A. It liquifies rapidly.

Q. Has any disease of fish previous to this case been traced definitely to bacteria?

A. Well, in Europe several bacteria have been described as coming from fishes.

Dr. Birge: I know that.

Mr. Marsh: But the organism has not been proved to be the cause of the disease. They merely mention it in that way. I really do not know of any case where this relation has been established, but you see, very little work has been done in that direction.

Dr. Birge: There was a time when I knew something about this general line of subjects, but since I have been engaged almost exclusively in executive work during the last four or five years, I have not kept so closely in touch with this work as I should have liked to do. Those who look at these matters from a practical rather than a scientific point of view, ought to appreciate that this work of Prof. Marsh's is of very great scientific interest. Although a vast number of water bacteria have been described, yet very few, if any, diseases of water animals have been shown to be attributable to such bacteria. Indeed when I used to keep up with the literature, the statement used to be made that there were no pathogenic water bacteria affecting water animals, although there were some pathogenic bacteria that could live in water for a certain length of time, but that none of the various diseases that affect fish and other fresh water animals were due to bacteria. On the other hand, that there were many diseases due to the coccidia, a totally different group of organisms, belonging, probably, to the animal side. It is quite a triumph for American science to have demonstrated so conclusively as Prof. Marsh has done, the relation between this important disease and bacteria. It is a hopeless kind of thing, however from the practical side, apparently, to demonstrate, because it seems impossible for us to do anything either to ward off the attack or, I suspect, to cure it after it is started.

Prof. Marsh: I have no hope whatever of a cure, although a year ago we tried formalin, but it was of no use.

Dr. Birge: How far are the springs in this case from the pond?

Prof. Marsh: Mr. Clark, I think, will tell you the exact distance. It is a few rods, I think.

Dr. Birge: You speak of these organisms as being in the springs. They ought not to be in the spring water, as it comes out of the ground.

Mr. Clark: The springs that Prof. Marsh has spoken of flow into the ponds, I should say, about 90 or 95 feet from the source; but from the upper or main spring it is probably 300 to 350 feet or a little further to the ponds. The water runs in a sort of an open, paved ditch and through one series of ponds. In another series it comes down through a pipe into a little pond and then passes underground, these two being all that are supplied from the main spring. Mr. Marsh's cultures are being made from waters of both springs.

Mr. Marsh: When Dr. Birge speaks of its being strange that bacteria should come from the water as the water comes from the ground, it does seem rather peculiar; but that must be the case, because the fry in the hatchery in the troughs now have the disease, or take it, or have had it; and one can hardly imagine how they could get it from the trough, and I do not think there is any infection introduced on the way from the spring to the trough. Whenever any trout are put in these spring waters they take the disease, and the spring water itself, as it comes from the ground, is much more to be suspected than the conduits through which it is carried.

Dr. Birge: I have no doubt that the bacteria are in the spring hole, but that they are in the water as it comes out of the ground seems remarkable.

Mr. Marsh: I go as far as that, too. The bacteria are localized in the spring and the only source of infection appears to be the ground. We disinfected the spring so thoroughly with chloride of lime that it looked as though we had killed everything in it, but the disinfection did not improve the remarkable condition.

Mr. Clark: But it pretty near killed some cattle several miles away.

Dr. Birge: The logical conclusion from that statement is that the baccillus is apparently tougher than a cow. (Laughter).

Mr. Marsh: It is strange, for if the infection comes from

the water why is it not more widespread and why does it not appear in all springs? My idea is that it is a freak of nature and a condition that we must simply accept.

Mr. Clark: I would mention one thing, perhaps, for Dr. Birge's information that Prof. Marsh did not state: The spring that is flowing entirely into the cement pond does not touch the air until it reaches this pond where the trouble exists. It commences under the northwest corner of our new hatchery and flows under the wall, through tile, and comes out near the lower corner of the building in a crock and iron pipe; it is all underground until entering this pond, and is the only source of water to it. The pond is impervious no water being able to enter through the sides or bottom. We even went so far as to tile-drain a little spring away that is under the cement.

Dr. Birge: It is entirely possible that the bacteria should have been introduced in these troughs. You say some trout began to die very soon after the water was introduced through them.

Prof. Marsh: Yes. That was on account of the injured snouts of the fish mentioned in my paper, which rendered the fish liable to infection from any pathogenic organisms with which the abraded surface came in contact.

Dr. Birge: How were those trout transported to the spring, to your hatchery?

Prof. Marsh: In the fish cans ordinarily used for that purpose.

Q. Could not the germ have been in those cans. Had not those cans been used where they could get the germ?

A. I do not know where they had been.

Q. Was the possibility of infection there absolutely excluded?

A. No, it was not. It could not be excluded. Those cans are a possible source of infection. There were other fish brought from Osceola in ordinary fish cans; and it was a hard trip. They are the ones which lived until the winter; but they were not injured.

Dr. Birge: What you say of the injury is perfectly reasonable; that that was the cause of the rapid death of the fish. In

that case one fish infected from the can would infect the entire pond.

Prof. Marsh: The can is a possible source of infection.

Dr. Birge: But not a probable one?

A. No, because the cans are used constantly for that purpose without producing infection.

Q. You had the disease there before the fish were transported?

A. Yes, but not in these cement ponds, of course.

Mr. Clark: There is one point that Prof. Marsh did not bring up. The fry that died in the troughs last spring when he was there were receiving water from the upper spring that had never had a fish in it up to that time—later we put some in it—but up to the time the fry commenced dying in the troughs in the house, the water came from the upper spring, which never, in all of its twenty-six years had had a trout in it.

The President: What was the percentage for mortality in the trough?

Mr. Marsh: They all died, except sometimes there was a little remainder that we called immune, but a very small per cent of the whole—I cannot say just what, but not over from 1 to 5 per cent—they practically all died.

Mr. Clark: There is one point in this matter that bothers me. Prof. Marsh has now almost come to the conclusion that this infection of bacteria is in the water as it comes out of the ground. Now, if that is a fact why was it not there and why did not this peculiar disease affect our trout before a certain time, not more than two years ago? Why have we not had some of it during the whole twenty-four years previous to that time? When we did have diseased trout (and we had an epidemic once before when Prof. Gurley was there) it was not pronounced to be the same disease.

Mr. Marsh: I cannot explain why it was there many years ago, but it may be compared to volcanoes which erupt intermittently. I think it is just some natural change in the earth below which brings this organism into the water. It is some change in the constituents of the water—that is the only explanation I can make of the infection starting up as it did.

Dr. Birge: Is not there another possible explanation of it?

There are quite a number of bacteria just on the edge of being pathogenic and which are ordinarily not pathogenic. That is true of the colon bacillus. You get a particularly virulent group of them and they will cause disease, while under other conditions they do no harm; and it is perfectly conceivable that you have got a pathogenic form of a bacillus which is ordinarily not pathogenic; and then it is also possible that the resisting power of the fish has been somewhat diminished; so that it may be both of those conditions or either of them in combination which has caused the infection.

Prof. Marsh: Do I understand you to mean that this organism may have been there all the time?

Dr. Birge: If it is a water organism I should conjecture that it has been there all the time.

Prof. Marsh: Yes, but it has changed its habit—that is a very reasonable supposition, but one can never find out about it, to a certainty.

Dr. Birge: If you find this organism in the water it may be entirely possible for you to find it in the water of other hatcheries, but not developing in a pathogenic way.

Prof. Marsh: Yes.

Dr. Birge: If you get it in the water here I think you ought to look for it where the disease is not known.

Prof. Marsh: You mean attempt to find a harmless form of it somewhere else.

Dr. Birge: Yes.

Mr. Lydell: Was there any vegetation in those springs previous to this disease appearing there?

Mr. Clark: Yes, all of our water there will grow vegetation, principally of a certain kind of moss, but there is not any great quantity.

The President: Would it form a scum on the top if allowed to remain?

Mr. Clark: Oh, no sir, nothing of that kind—it is a growing vegetation of a limy nature, that is cleaned out from time to time.

INBREEDING POND-REARED TROUT.

BY ARTHUR SYKES.

In submitting this paper the writer does not profess to speak with authority on the subject under consideration nor desire to pose as a discoverer or a pioneer. If it should appear that the subject is already well understood and so simple as to be unworthy of consideration here, an apology for the writer may, perhaps, be found in the fact that he has never heard the subject discussed in any of its phases in relation to fish culture or read anything on the subject emanating from fish culturists in any journal or report, not excepting the reports of the American Fisheries Society. Much has been said and written about methods and results of propagation; but little thought, it seems, has been given to the foundation on which we work or the quality of the material of which it is composed, i. e., the potency and vigor of the parent fish and the embryo.

So far as the writer has been able to ascertain the principles underlying the breeding of domestic animals, here exploited, have not been applied in fish culture excepting in a very limited way; and no fish culturist has put those principles to a practical and complete test. If, however, my knowledge of what has or is being done is not complete or my surmises not entirely correct, it is hoped that the attention now called to the subject may be of use to some breeder; and that a thorough discussion of the subject by the Society may be had for the benefit of those who, like the writer, confess to a mediocre knowledge of an important subject while willing to contribute his mite.

The first stock for the pond culture of trout was doubtless obtained from waters in which the fish was found in its primitive state. It was with this stock that the protected propagation of trout in ponds on a large scale was begun. The method of breeding pursued, which is still in general practice, is as follows: The spawn is taken from the female fish of the breeding stock, large and small indiscriminately. The eggs thus taken are fertilized with milt obtained from the male fish of the stock with the same

lack of regard as to the size, vigor and color of the fish. In this process, I repeat, little or no attention is paid to the size, vigor, or color of the fish spawned. Everything is threshed out, so to speak, that will produce eggs and everything is stripped that will produce milt.

The eggs thus taken are laid down in hatching troughs and incubated. The first of the season's crop of fry is usually saved for the use of the hatchery to increase and replenish the breeding stock in the ponds. The remainder of the crop is sold by the private hatchery or planted in public streams by the state hatchery as the case may be. The fry saved for the use of the hatchery is transferred to ponds, and here protected from enemies without, and as far as possible from cannibalism within. This system has been called protected propagation, and very properly, for you will note that unlike their brook-reared cousins, they are protected from beginning to end.

In saving the first of the season's crop for the hatchery ponds the fish culturist, or many of them at least, take the first of two steps in practice toward keeping the stock of trout in their ponds from deteriorating in quality, size and color. The second step consists of purchasing from time to time a few thousand eggs or fry from some other hatchery where the fish are bred in exactly the same haphazard way as a rule.

The first of the season's crop of fry is saved as it is found to be stronger, larger and perhaps more hardy than the fry hatched later. The early hatched fry usually comes from the older fish, hence has not been inbred as much as that hatched later. Fry is purchased from other hatcheries for the infusion of new blood in the breeding stock. This, with some variation in individual cases, is, in a general way, the system of trout breeding in vogue.

The results of this system of breeding under the writer's observation are, that the fish deteriorate in color, size, vigor and productiveness. A considerable number of barren fish are found. The markings of the fish are variable and indistinct, and the color of the flesh changes from pink to white.

It is possible, perhaps probable, that all the defects noted here in pond cultured trout are not due to what I consider a loose system of breeding; but it has been established almost beyond doubt that deterioration along the lines mentioned takes place in

breeding domestic fowl, animals and plants under a similar haphazard system: and I deem it fair to assume that if we get similar results from a similar system that the same causes have produced those results.

Sir James Gibson-Maitland, Scotland's greatest fish culturist, in speaking against the introduction of foreign trout into the streams of Scotland said, "Civilization must breed its trout as its cattle, or civilization will have no trout." The truth of this statement is evident to me, though I have no doubt he wrought better than he knew.

The ordinary breeder of domestic animals considers it necessary to introduce new blood into his yards from time to time by selecting a male to breed to his stock. In making this selection he does not choose a scrawny, undersized specimen, but obtains the best his means and other circumstances permit. He saves the best specimens of his flock to mate to the male thus selected, and in this way he prevents degeneration of his stock and perhaps increases their size and usefulness.

The fish culturist does not as a rule make a selection of his stock with a view to increasing the size and hence the usefulness of the individuals. His matings are haphazard and the results of a corresponding nature. It is true that he introduces new blood into his ponds, but of what avail is such new blood if it is of the same quality as the old?

The careful and precise breeder of domestic animals selects and breeds his stock to the end that he may improve them, and to perpetuate the good qualities in the offspring from generation to generation; but the system practiced by the trout culturist has for its only object the perpetuity of the species, and the results indicate that he would ultimately fail even in this.

Among wild birds and animals, and I may say fishes, the law of natural selection operates to insure indefinitely the continued existence of the species until the environment changes in such manner as to cut off its existence without regard to the natural laws of breeding. In their primeval state, there is no question but birds, animals and fishes inbreed closely; but the laws of nature operate in such manner that only the strongest and most vigorous of the offspring survive and reproduce. The weaklings

are destroyed by the inclemencies of the weather or their natural enemies.

The markings of the individuals of the same sex in most species do not vary under the same environment in the wild state. It is claimed that a dozen quail of the same sex taken from as many different localities in the United States would show little or no variation in the markings of their plumage; and the species does not perceptibly vary in size at maturity. It is probable that if a single pair of strong vigorous quail were again released as in the time of Noah and were to multiply and their progeny live through centuries in fields constantly rich with food, yet so surrounded with natural enemies and subject to such conditions as would tend to cut off the weaklings of the progeny, they would increase in size as a species; and notwithstanding inbreeding would be perpetuated indefinitely. If the food supply was insufficient doubtless the species would decline in size. If no conditions prevailed to cut off the weaklings and inbreeding occurred for any extended period, the species would dwindle away.

Nature's laws provide for the indefinite existence of the species and the environment largely determines its physical characteristics.

The breeder of domestic animals and fowl conforms to Nature's laws by permitting only the largest, strongest and most vigorous of his flock to reproduce. He fixes the environment in such manner that the desired size is insured and thus maintains or increases their size as a whole or a species from generation to generation. He may inbreed closely for many years, perhaps indefinitely, yet by careful selection not impair the size or vigor of the individuals of his flock; but on the contrary most certainly add to their beauty and their usefulness. In like manner, the fish culturist can in my opinion, by careful selection of his breeding stock produce a fish of uniform markings, of larger size, of increased vigor and greater beauty and usefulness.

I have no doubt but many practical men will regard as visionary and impractical the theories here advanced when applied to fish culture in ponds; but with some knowledge of breeding of domestic animals, after eleven years of service at a trout hatchery and much of this time given to the practical workings thereof,

the writer is convinced that these theories can be applied in the pond culture of trout and that they will mean something when so applied. They will mean that the trout in our ponds will be more vigorous and healthy: that they will be larger; that they will produce more spawn; that a larger per cent of the spawn will hatch; that a larger per cent of the fry will live; that the output of the hatcheries will be increased; that more trout will be planted in our public streams; and that larger and handsomer trout and more of them will be taken from those streams with greater delight and satisfaction to the fisherman.

The system of breeding which I have sketched here would entail but little extra expense or trouble on the trout culturist. The only additional apparatus needed in the usual outfit for taking spawn at a hatchery would be an extra tank to hold a few of the finest specimens found in the ponds.

The usual procedure in taking spawn at a trout hatchery is to confine the fish to a spawning pen or raceway and with a dip net transfer a few at a time to a tub containing some water, from whence they are handled by the spawn takers. The extra tank mentioned should be located near by and supplied with water, and whenever the spawn takers find a nice specimen of either sex, strong in size, color and markings, such specimen should be transferred to the tank mentioned. After the regular stock of breeding trout has been handled over, the eggs may be taken from the fish in the tank and fertilized by the best males saved for the purpose; and the eggs thus obtained should be given a separate place in the hatchery. The fry from these eggs should be kept separate and finally transferred to the hatchery ponds to form a part of the hatchery breeding stock. No other fry should be saved for breeding purposes.

When it is thought desirable to introduce new blood, this should be done by obtaining a number of mature specimens of good size, color, etc., to be used in connection with the selected breeders from the home stock rather than by purchasing a large quantity of fry or eggs bred in the usual way.

The mature fish selected for the introduction of new blood may or may not be wild fish. If the progeny is to be planted in wild, unprotected streams, wild fish would be preferable for this

purpose; but in either case the specimens selected should be of good size, color and markings.

I am convinced that the law of "Like begets like" applies in the same manner and to the same extent in the propagation of fish that it does in breeding domestic animals; and if it is desirable and profitable that only the fittest be selected in breeding in the one case, it is just as desirable and just as necessary that such selection be made in the other.

We should aim to improve the quality of the fish in our ponds and through them the quality of the fish planted in the streams. That there is room for improvement here is indicated by the fact that many expert fishermen claim to be able to tell from the appearance of the brook trout they catch in our streams whether the fish was planted from a hatchery or came from the wild stock in the stream. I do not believe this is possible as a rule, but it is quite likely that the old trout fisherman can see a difference in the color and markings of the hatchery trout which he catches today as compared with the wild fish which he caught twenty-five years ago.

If we are right in claiming that the quantity of trout which our streams produce is dependent on our hatcheries, then we must also be held responsible in a large measure for the quality; and in this connection the fish culturist should always remember that on the vigor of the parent stock depends, not only the quality of the offspring, but the quantity as well.

DISCUSSION OF MR. SYKES' PAPER.

Mr. Titcomb: I heartily concur with the writer in all that he has said about inbreeding and getting a good quality of fish by introducing new stock, and I may perhaps say in that connection that the commercial fish culturists almost all do that in the East. On the Massachusetts coast where the commercial hatcheries are so plentiful, they very frequently call upon us for the eggs of the wild trout and rear those to mix with their brood stock, and thus obtain new blood. Some of the hatcheries introduce new blood by that method every year. I think that this idea can be carried out beyond the commercial hatcheries and beyond our brood stocks at any of our state hatcheries. I think that the changing around of the stock of trout in our natural

ponds will tend to strongly invigorate the trout. In traveling through the trout country of the Laurentian Mountains in Canada I was very much surprised to find lakes teeming with trout where the stock had apparently run down. I could not find any other reason for it except in breeding. The ponds were of large size, full of food, but the fish were small and the eggs of very inferior quality. In fact, at one place where I was trying to collect the spawn of the wild trout in the Laurentian Mountains, we took something like 6,000 fish on the spawning beds, and in a week's time got less than 100,000 eggs from those fish. The eggs were inferior and seemed to be diseased. The fish themselves were apparently all right—good eating, and rather thin, notwithstanding the abundance of food. That idea of introducing new stock I think should be carried out very frequently in connection with our work. I have carried out that idea, so far as possible, in connection with the collection of eggs of the wild trout from different waters. When returning a proper quota of product of these eggs to the waters where we made our collections, instead of returning the product of the eggs that were collected at any particular station, we took the hatch of eggs taken from some other point, and each year changed them around, so that at all of our collecting stations new blood was introduced annually.

Dr. Birge: I would like to ask whether any fish culturists have tried this method Mr. Sykes speaks of of selecting the individual fish to breed from to keep up the stock of breeders.

Mr. Titcomb: I know to a certainty that one of the fish culturists in Mr. Lane's neighborhood selects the larger fry—that is, when he sorts out his fry he takes the larger ones. Sometimes you will find, as you know, fry two inches long in with fry of the same age or about an inch in length.

Another point we might consider is that the commercial fish culturists are rearing trout for the market, and the market demands a small fish. The result is that they are taking most of their eggs from fish a year and a half old, what we call yearlings, and those eggs are very inferior to the eggs of the fish a year older. The United States Commission in obtaining eggs have adopted a rule not to accept any eggs from fish less than two and a half years old, for that reason, but the tendency of distributing

these eggs from the younger fish all round the country, selling them to state commissions and private hatcheries, is toward the introduction of an inferior fish.

Mr. Lane: I would state for the benefit of the society that I always manage to select my fish from the eighteen months' old fish, but I select them when they are fingerlings; that is, I will, for instance, select them this fall from the fish hatched this spring, and from those fish I take the stock to replenish my stock with. As Mr. Titcomb says, I have introduced new eggs from other hatcheries, but I never have thought that the inbreeding ever hurt my fish at all. I have not seen any ill effects of it. But I have only been at it seven years, and perhaps it would not occur in that time.

Mr. Titcomb: Introducing eggs from other hatcheries counterbalances the inbreeding.

Mr. Lane: I never thought that they did deteriorate by inbreeding, because of putting in this new blood—that is what I meant to infer, that the introducing of this new stock kept the old stock up to the standard.

Mr.Titcomb: That is just the point he makes, that you should do that.

Mr. Lane: That is what I have done. But I have saved the stock on the very principle that you mentioned, that the market does not require large fish. When I send them to New York for food they do not want over half-pound fish; they will take them as high as three-quarters of a pound, but from one-quarter to one-half a pound is as big as they want; and in that way good, nice fingerlings and two years old are plenty large enough. So we do not keep fish until they are two and a half years old; we cannot keep them to sell many eggs from, and that is the reason that these commercial hatcheries sell them young and have nothing but the eighteen months old fish to take the eggs from.

Mr. Clark: There is one point in this paper in which I do not quite agree with Mr. Sykes, and that is in reference to the color of the eggs of fish that are bred in and in. I had the impression from the paper that the color of the eggs indicated that the fish had been so bred.

Dr. Birge: I did not so understand it.

The President: He thought the markings became less distinct and clear.

Mr. Clark: He spoke of the eggs.

Dr. Birge: I recall nothing of the sort. He mentioned selecting fish of good colors.

FEEDING: ITS EFFECT ON GROWTH AND EGG PRODUCTION.

BY W. T. THOMPSON.

The relation of food to growth and production has ever been a most interesting subject for speculation and experiment; not alone to fish culturists or to the present generation, but to all mankind and throughout all ages this problem, in its broader sense, has appealed to each individual in a peculiarly personal way. The farmer studies his soil, what food will best promote the growth of his crops, and enable him to reap the largest harvest from his fields. The stockman, that he may produce the best quality of beef, mutton or pork in the shortest time, and with the largest margin of profit. It is a subject pregnant with interest to the gardener and the horticulturist. It appeals to the machinist and engine driver, what fuel will produce the most power at the least expense? It is not absent from one single vocation. It is a strongly pertinent query even in the home life, what foods or combination of foods will promote the best growth and development of the children; preserve the health and strength of the adults; prolong the period of productiveness and usefulness in the bread-winners?

In the earliest dawn of history, we read of families, tribes and even nations, migrating from place to place to secure better and more abundant pasturage for their flocks and herds, thereby increasing their own food supply. This was one of the very first questions man was called on to grapple with. It still presents a splendid field for investigation and experiment. At no time has it received a larger share of attention than it does today. Scientists and chemists of the highest order are giving this food problem their closest attention. The question of constituents, proportion, amount, ease of assimilation, etc., is still puzzling the wisest minds.

My own study has not been limited to the circumscribed area included by my topic. It has been my privilege and pleasure to consider it in its broader relations to animal and plant life gen-

erally. Each germ, each embryo has its possibilities, whether it ever attains to them or in what measure it falls short depends on the surrounding conditions during the period of growth, whether these be favorable or the reverse. Herein this same question of food supply assumes a position of primary importance. The Percheron and the Clydesdale, with their grand proportions, their majestic bearing and their remarkable strength, trace back to the same ancestry as the shaggy, diminutive Shetland. The food conditions have been different. There is but little resemblance between the luscious Northern Spy or Baldwin from our highly fed and cultivated orchards, and the wild crab or seedling growing by the wayside.

In the present paper I shall consider the food question in its relation to fish life only from the standpoint of quantity. The consideration of its quality, its proper combinations of elements to produce the best results, being left for some later day, perhaps for some later generation. We will assume that experience has, to some extent, taught each fish culturist what food or foods are the most economical and satisfactory under his own peculiar conditions.

The results which I shall endeavor to bring to your attention were not obtained in experimental work under peculiarly favorable conditions, but where the outcome of the regular work of the Nashua Station, under charge of Superintendent Waldo F. Hubbard, and obtained in spite of the usual drawbacks incident to a first season's work at any new station. There was no intention of producing any abnormal growth of egg production, merely to ascertain in a practical way the effect varying quantities of food would have on health and growth. Later the matter of egg production was also included.

The lot of fish in question were brook trout, numbering about 5,000, hatched in the spring of 1900, and were reserved from the fall distribution to be reared for breeders. Prior to this time, they were all treated alike, fed generously on beef liver, which diet was continued throughout the entire period. About the first of October, 1900, they were sub-divided into four lots and placed in winter quarters. At this time they averaged from one and a half to two pounds per 100. Lot No. 1 received practically all they would eat. Lot No. 2 about 80 per cent, while Lot No. 3

were fed 65 per cent, and Lot No. 4 only about 50 per cent of their capacity. Lot No. 4 was in a larger pond where they secured some natural food in addition to their daily rations. From this time until the following August they were fed twice per day, then but once till the commencement of the spawning season (November) when they were fed but three times per week. No markd difference was noted as to health amongst the various lots, although the death rate, which was only nominal, was a trifle higher amongst the smaller fish. In the matter of growth however the difference was most markedly in favor of those receiving the larger rations. A monthly record of the growth of Lot No. 1 was kept for one year, as follows:

Weight per 100 fish:

Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug	Sept.	Oct
2 lbs.	4½	5¾	8¼	11	12¾	16	20	28	34	45	55	60

This included both males and females, the former being naturally somewhat larger. One day during the spawning season ten representative females were selected from each lot and weighed, prior to stripping, to ascertain the comparative growth:

Ten fish from

	Lot No. 1.	Lot No. 2.	Lot No. 3.	Lot No. 4.
Weighed	5½	3½	2¾	2

Spawning was practically over by December 18th, and the few spawners remaining in the various lots were put together for convenience, but these unripe fish are noted with their proper lot in the spawning summary which follows:

SPAWNING SUMMARY TO DEC. 18, 1901, INCLUSIVE.

	Lot No. 1	Lot No. 2	Lot No. 3	Lot No. 4	Total
Females spawned,.....	111	351	513	735	1710
Barren females,..	none	20	27	55	102
Total Fem in spawning sum..	111	371	540	790	1812
Per cent females spawning,..	100	95	95	93	94
Per cent females barren,. ...	0	5	5	7	6
Eggs taken,.....	104,400	199,800	234,900	285,750	824,850
Average No. Eggs per fish,...	940	560	458	389	482
Females unripe Dec. 18,... ..	16	51	39	23	129
Total females including above,	127	422	579	813	1941
Total males (lots not kept separate)	.....	.....	.....	.....	3102
Total males and females,.....	.....	.....	.....	.....	5043
Per cent females,.....	.....	.....	.....	.....	38.5
Per cent males,.....	.....	.....	.....	.....	61.5
Average size (inches)	10–12	8½–10½	7–9	6–7½	.....
Aver. weight females only (oz)	8.8	5.6	4.4	3.2	.....

Now let us assume for the sake of comparison that Lot No. 4 is an average of the twenty-one months' old brook trout reared throughout the country. Certainly fish of this age weighing 3.2 ounces, probably 3.5 ounces with males included, (commercial fish culturists begin to market their fish the following April when they desire a standard weight of 5 ounces or three fish to the pound) with 93 per cent yielding spawn, averaging 389 eggs each, would seem to be up to the standard, and we obtain the following convincing showing as to the value of the extra food supply:

	Per cent extra food	Weight oz.	Excess wt. oz.	Per cent extra weight	No. Eggs	Excess Eggs	Per cent excess Eggs	No. Eggs to the Liq. oz.
No. 4	.....	3.2	.....	.....	389	.....	.....	460
No. 3	30	4.4	1.2	37.5	458	69	19	450
No. 2	60	5.6	2.4	75	560	171	44	408
No. 1	100	8.8	5.6	175	940	551	141	378

A query naturally arises as to the exact source of this excess egg production. Is it the direct result of the stimulation of the ovaries, by the extra food supply, to such an extent as to increase the number of embryos on the one hand, or on the other, is the lesser nourished fish unable to develop and mature the full number of germs initiated? Courtesy to other contributors prompts me to refrain from trespassing further on the very limited time at the disposal of the society, by following up this branch of my subject further than by the suggestion that it will afford the student a very interesting and profitable field for further thought during some leisure hour.

Before closing I wish to state very positively that I do not advocate full feeding for adults. If range, temperature, and conditions generally are favorable, nothing but the best of results will follow such a course with fish under two years of age. The remarkable growth during this period coupled with the extensive demands made on the system in maturing the product of the ovaries, can only be provided for by a most generous system of feeding.

For the benefit of those who may wish to study this matter more closely, I attach herewith a detailed record of our spawning operations for publication in the transactions of the Society.

DETAILED RECORD OF SPAWNING, NASHUA STATION.

	LOT No. 1		LOT No. 2		LOT No. 3		LOT No. 4		Total Fish	Total Eggs
	No. of Fish spawned	No. of Eggs Taken	No. of Fish	No. of Eggs	No. of Fish	No. of Eggs	No. of Fish	No. of Eggs		
Nov. 8..	....	.....	7	4950	35	17100	104	48600	146	70650
Nov. 12.	....	.....	13	8550	9	4950	81	34650	103	48150
Nov. 14.	4	4500	15	9000	39	22050	68	29700	126	65250
Nov. 16	6	4950	18	10800	32	15750	78	31950	134	63450
Nov. 18.	5	3600	16	9000	44	18450	76	31050	141	62100
Nov. 21.	9	8100	35	20700	41	18000	32	14400	117	61200
Nov. 23	7	5850	29	17100	66	29700	52	17100	154	69750
Nov. 25.	10	9000	36	19350	48	18900	46	15700	140	62950
Nov. 27.	11	8100	28	15300	22	10800	23	6750	84	40950
Nov. 29.	4	4950	17	10800	21	17100	27	10350	69	43200
Dec. 2..	16	18450	43	28350	60	27900	30	11250	149	85950
Dec. 5..	16	13500	35	18000	50	17100	44	13950	145	62550
Dec. 7..	1	900	16	5400	9	3150	20	4950	46	14400
Dec. 9..	4	4950	14	7650	8	3150	10	3650	36	19400
Dec. 11.	5	4950	10	5400	10	2700	17	4500	42	17550
Dec. 13.	5	4500	6	3600	11	5400	8	2700	30	16200
Dec. 16.	6	6750	5	2700	5	1350	13	3150	29	13950
Dec. 18	2	1350	8	3150	3	1350	6	1350	19	7200
Total..	111	104,400	351	199,800	513	234,900	735	285,750	1,710	824,850

FISH CULTURE ON THE FARM.

BY J. J. STRANAHAN.

It is safe to presume that the members of the society will think that this subject has been selected because the writer is too lazy to prepare a paper along more scientific lines and if this be the case, the presumption will be well founded, although much of interest and value may be said on fish culture on the farm, a subject that has been too long neglected by this association, the United States and state fish commissions and by fisheulturists generally.

With our public waters rapidly becoming depleted through excessive fishing, in spite of the good work being done by the hatcheries, where are we to look for the fish to fill the very rapidly growing demand, if not through water farming? Of course the output of ocean, lake and stream may be held in statu quo or possibly increased to some extent by reasonable restrictive laws and by the work of fisheulturists, but with the rapid increase of our population and the further growth of consumption through improved transportation facilities, the limit has doubtless already been reached and any permanent increase of per capita supply must come through covering what is now unproductive land with water, thus adding to the output of fish beyond what natural waters would make it, and making many fins grow where none at all grew before.

There are vast areas in all of the states, probably equal in the aggregate to that of the Great Lakes, which now produce virtually nothing and much of which might be made to furnish abundance of fish, with comparatively little expense.

Not only would the conversion of this waste land into water areas increase and equalize the rainfall to some extent, but it would measurably decrease the liability to disastrous floods and equalize the flow of streams. But this is only incidental to my text and not really germane to the subject.

Fisheulture on the farm is, nine times out of ten, a failure, and generally so because of three main causes, none of which,

owing to lack of space, can be fully treated here. We will take first in order the failure to properly construct the embankments which are to retain the water. Very briefly stated, the sods, brush, grass and other rubbish should be cleaned away down to the solid earth over the whole extent that is to be covered by the embankment. Then a trench say two feet wide and as deep should be plowed lengthwise throughout the whole extent that is to be covered by the embankment. The earth of the embankment settles into this preventing leaks which are almost sure to follow along the union of the old and well packed earth and the new soil, if this is not done. No brush, sods, stumps or other rubbish should be permitted to enter the embankment. Use nothing but clear earth and if the soil be gravely to the extent that it is likely to permit the water to filter through the inner face of the embankment, that is, the one next to the water, should be faced with a foot of clay or other impervious soil. The plow and scraper will be found the most economical, unless the lay of the ground is such as to prevent, when wheel barrows will be necessary, and the team should be kept on the embankment while going and coming as much as possible, so that the earth will be packed as much as possible and prevent sloughing when the water is let on. If the embankment is made of proper width at the bottom and the correct slant given to the sides—observe the slant given by nature in your vicinity—you will have an embankment that will last for generations and give you no trouble.

All ponds should be provided with a sluice or outflow through which the ordinary discharge flows and through which also you may discharge the water when you wish to draw down your pond, a matter strictly indispensable to successful pond culture. The sluice may be most economically made of two-inch plank a foot wide and should be long enough to go clear through the embankment, the outflow, or perpendicular part being securely spiked to the horizontal part which runs through the embankment and is situated low enough to draw the water entirely out of the pond. The face of the upright, that is, the side opening towards the pond, is, of course, left open, the box being closed on three sides, the open side being left for the discharge of the water. Two grooves should be provided by

nailing three strips onto each side plank of the upright. Into the back groove boards an inch thick and three or four wide are slipped, these retaining the water at its proper height, the surplus being discharged over the top board, and these being removed one at a time when you wish to lower or empty your pond. Into the front groove the frame of your screen is slipped from above. This should be covered with galvanized wire cloth with about one-half inch mesh. This should be used only when the pond is being emptied or lowered, for the few fry which will escape ordinarily amounts to nothing, in fact, you are sure to have too many after your first hatch in any event.

The second cause of failure is the selection of too high-toned fish and the introduction of too many species. Not over two or three species should be put into any pond of a few acres or less, and the more desirable ones from your vicinity are likely to prove the most successful. To introduce brook trout, unless you have a very large spring of cold water, will lead to failure, and no matter how much water you have and how cold it is, you would better leave the trout alone unless you know something of their culture or wish to study their habits and make a pastime of their cultivation. The same is true of the black bass, unless you have a pond of several acres or wish to sacrifice a good supply of fish for your table for the sport of capturing a few bass with rod and line, which, after all, can be best accomplished in some nearby public water, leaving your pond for the cultivation of those fish which will provide you the maximum of good food with the minimum of trouble and expense. If black bass is decided on, in nine cases out of ten, north or south—the small-mouth is not indigenous to the south south of north Georgia—the large-mouth species should be selected, the only exception being where the pond is supplied with an abundant supply of cold water and where the bottom of the pond is gravely or rocky throughout a considerable portion of its area. If the bottom of the pond is soft, suitable for the growth of aquatic vegetation, then the large-mouth should be introduced by all means, if bass are to be selected at all.

The best all round fish for small ponds, north or south, is, in the opinion of the writer, what is known as the marble or mottled catfish in the north and the speckled cat in the south,

Ameiurus nebulosis, from nebulous, clouded, which is easily identified by its square tail, which is not forked in the slightest degree, and by its mottled skin north, while in the south it is covered with black specks on a light slate background. This is an excellent fish, making a rapid growth for the first two years in particular, cleanly in its feeding habits, being in no sense a scavenger, almost omnivorous in its selection of food and growing to weight two or three pounds, often attaining to one pound when a year old, when the range is ample and the food abundant. This fish does not interfere with other species in the pond, either through destroying the young or the eggs of the other. In fact, any nest-builder, such as the rock bass, black bass, bream or sunfish will defend its nest and eggs against all comers, even if it be a mud turtle of many times the weight of the fish. Taking it all in all, the writer believes that this fish will produce a greater weight of good food from a given area of water than any other that swims.

Taking the country as a whole, the writer believes that what is known as the blue-gill sunfish north and the bream south is the next best fish for small ponds, although he would possibly modify this statement to let in the rock bass where the water supply is especially good and the considerable gravel entering into the soil in the bottom of the pond, and it is possible that this fish may prove a desirable pond fish in the south, it having been acclimatized in Texas, where it is doing well in public waters. The blue-gill, or bream, *Lepomis pallidus,* is of excellent quality, dresses to waste but little, is a rapid grower and is esteemed by many as next only to the speckled brook trout as a pan fish, while my good friend and enthusiastic angler, Mr. C. T. Hasbrook, of Cleveland, O., claims that when taken on a fly with light tackle, he offers sport as a game fish second only to the speckled beauty of the brooks. Probably Mr. Hasbrook is the best posted gentleman in the world today on this fish, and he considers it one of the most desirable for table as well as at the end of a line. While it sometimes attains a weight of three or four pounds in the south, a pound will be found to be about the maximum for this fish in ordinary pond culture. Like the speckled cat, it is not predaceous to any appreciable extent, defending its own nest vigorously and leaving others to do the

same unmolested by him. It is omnivorous, eating almost anything that you give it, provided the food is clean and that decomposition has not set in, and finding much of its own food in the pond in the shape of small crustacea, larvae of insects, worms, etc. If rock bass are to be had in your vicinity and not the blue-gill or bream, it would probably be best to introduce them.

In stocking your pond, half a dozen pairs of each species are a great plenty and even these will overstock your pond the first year if two or three pairs of each bring off broods. It is by far the better plan to collect adult fishes from near by waters for stocking your pond. These will bring forth young two years earlier than the fry furnished by the United States or state hatcheries, besides, being acclimatized, they are likely to do better.

If black bass are to be introduced it is well to also put in brook minnows, such as chubs, shiners, suckers, etc., but care should be exercised that undesirable forms, such as pickerel, etc., do not slip in with them and lead to serious regrets later for it is easier to keep out undesirable fishes than to eradicate them when once established.

The third, and one of the most fruitful causes of failure in fish-culture on the farm, is over production. The first year's hatch of the fishes above recommended with the numbers of adults suggested, will overstock any ordinary pond of a few acres. Just as soon as the fish are large enough, probably in the fall of the year when they are hatched, the owner should begin catching them for the table. They will not be very large but sufficiently so to make a nice little pan fish and their quality will be fine. The more you can get out and consume the better. At the end of the spawning season of the second year your pond should be drawn off and the surplus fish turned into the near by stream or lake, thus paying back to nature the debt you owe her.

It is a hard matter to advise just how many fish of each species should be returned to the pond, the natural inclination being to make it too many. One hundred of your yearling black bass and twice the number of bream and catfish is plenty for each acre of water, and too many, unless you are pretty persistent in

catching them out, and not over that number of fry should be retained to come on for the coming year's supply.

To recapitulate: Make your embankment good and safe; don't try to breed too high-toned fish; look to it that your pond does not become overstocked and, other things being equal, you will succeed.

DISCUSSION OF MR. STRANAHAN'S PAPER.

Mr. Titcomb: I think Mr. Stranahan has brought out one very important point there. In the first place, this question of fish culture on the farm is very important, and it is not taken up enough in this country, and a great deal might be made of it. I can see in my work in Washington that this form of fish culture is growing very rapidly, especially in the west and southwest.

But he brought out in the paper one other point which every fish commissioner and culturist must appreciate, namely, the fact that people who know nothing about what they want will apply for some variety or species of fish that does not inhabit their waters—they want something new. Somebody up in Connecticut will send down for Calico bass, for instance, when they have black bass or trout. They may have all the fishes that are desirable in their waters, but they want something entirely new. It is a great mistake to try to get too many varieties of fish in a pond. We had an application in New England in the past week where they had black bass, pickerel, sunfish and yellow perch, and they wanted us to introduce the rock bass. In my opinion they had as many varieties as the pond could well sustain, and it is a great mistake to try to get in too many varieties.

Mr. Lane: Mr. Wood in his paper in last year's report said something about the different kinds of parent trout that they received eggs from, and I inferred that he preferred the wild trout. I have found in one instance that I shipped some trout eggs to Pennsylvania, and 50 per cent or more of them died, and the man wrote me that it was pretty near a total failure. But out of the same lot and on the same day there were some shipped into the state of Maine, and those I have been informed, hatched out 94 per cent. They were the very same eggs exactly. I wish I knew the cause of the trouble, but I think I have learned some-

thing in the discussions I have heard here on that point. Now, I would like to know what difference there is between the wild trout egg and a good, domesticated trout egg, for hatching purposes. I do not know, but I should like to.

Mr. Titcomb: That subject I have studied. I have taken every year for the last six or eight years, eggs of wild trout from different ponds and streams and have been handling at the same time the eggs of domesticated trout from commercial hatcheries. The eggs from the wild trout in every instance have proven to be the most hardy, and have produced the most hardy fish; but I am not prepared to say that your fish are not just as good for your waters. The longer I investigated this question the more I was inclined to believe that possibly these domesticated fish had become accustomed to a certain quality of water. I think Dr. Bean has touched on this point in connection with the changes brought about by domestication. My waters were all extremely cold in the winter, and these eggs of the wild trout naturally were accustomed to this extremely cold water. I think possibly that the eggs of the domesticated trout introduced into our waters suffered very much as do the rainbow trout introduced into our extremely cold waters. I do not think it is all weakness in the fish, because in many instances these domesticated eggs have been reported from other stations as yielding a very large per cent of fry, and in some cases have yielded well in fingerlings, also.

Mr. Lane: Does not the condition of the fish depend a great deal on whether they are allowed to breed in and run out, or whether new stock is introduced?

Mr. Titcomb: Oh, yes, I think you want to introduce new blood in your commercial hatcheries every year, and you cannot do that better than by introducing the product of the wild eggs.

Mr. Lane: Whether the domesticated parent trout were properly cared for is what I am trying to get at. I believe Dr. Bean said that inbreeding would injure the quality of the eggs.

Mr. Titcomb: I think if you take a commercial hatchery and rear trout year after year, and then take the product of your own brood stock and rear them up, you will gradually weaken your stock; but in these comparisons I was making between wild and domesticated eggs, I would say that I received

domesticated eggs from four different commercial hatcheries and compared them with the wild eggs, put them in the troughs right beside the wild eggs, and gave them the same treatment. No disease existed either with the wild eggs or domesticated eggs.

SOME REMARKS ON THE RAINBOW TROUT, THE TIME FOR PLANTING, ETC.

BY GEORGE A. SEAGLE.

The rainbow trout are unlike the brook trout in several respects; they grow larger and inhabit larger and warmer streams, and vary much more in form and color. Their rate of growth is hardly equal to that of the brook trout under similar conditions, but the brooks reach maturity earlier. In domestication the rainbows can hardly be considered cannibalistic in their habits, although occasionally one is observed in the act of swallowing his smaller and weaker brother. Their natural food consists chiefly of worms, larvae, crustacea and the like, but in their wild state necessity compels them to seek such food as may be found. If they do not find their preference they must accept something else, and in that way they get a taste of fish and the cannibalistic habit is established.

Much has been said and written about the time, or season, for planting trout in streams, and it seems to me that the success of the work must depend largely upon this point. In my opinion there is but one favorable season, and that is spring.

With the warming up of the waters the natural food makes its appearance, and fish planted in the streams at that time need not go hungry. They can select such food as their stomachs may dictate—worms, larvae, or young minnows. Contrast these conditions with those existing in the fall and winter months, and you have all the argument necessary in favor of spring planting. In the fall and winter the streams are practically barren of food, nothing left in them except minnows, and they have become too large to serve as food for the young trout. Therefore I would plant trout in the spring and let them keep pace with their food, and when cold weather comes on, and food becomes scarce, they will be more able to cope with the situation before them.

It has been argued that small fry are too delicate to take care of themselves in open waters, but if that be true how can we expect them to multiply in the streams? If fry from two to four

months old, and averaging from one to two inches in length, cannot survive what may we expect of the eggs, and the alevins, which have been deposited in the streams by the parent fish?

Again, if the young trout were planted in the spring season the output of the hatcheries could be more than doubled, and the assignments to the streams could therefore be made much larger. The saving in food would more than pay for the increased production, and the cost of the distribution would be lessened.

DISCUSSION OF MR. SEAGLE'S PAPER.

Mr. Seagle: Before reading my paper I desire to say in regard to it that I have expressed my views as to the matter in hand as briefly as possible. I simply want to introduce it here and have it discussed by the members of this association, and see how many, if any, agree with me.

Mr. Titcomb: Do I infer from your paper that you would plant all trout in the spring—brook trout as well as rainbow?

Mr. Seagle: Yes, sir, I would plant them as early as possible after the spring season opens, and the waters begin to warm up.

Q. At what age after feeding—you feed for a while?

A. Yes, sir; our fish hatch from December 1st to March 1st, and I would plant them in April and May. They are then two to two and a half inches in length and in every respect, I think, able to take care of themselves.

Mr. Peabody: How large do rainbow trout grow down there?

A. Six and a half pounds is as large as we have grown any in our ponds; although they grow much larger in some sections of the country, especially in the west.

The President: You are in the southwestern part of Virginia?

Mr. Seagle: Yes.

Q. And your spring comes on a little earlier there than it does up here?

A. Yes, sir. April would be a favorable month for us, that is, in most years. We usually have nice weather, especially after the middle of April.

Mr. Peabody: Do you have the brook trout in the same streams with the rainbow trout?

A. Not naturally so. We have streams that used to be stocked with brook trout, but they are pretty well extinct now.

Q. Do they thrive together, with you?

A. I think they would, except that brook trout, of course, have more of the wild nature.

Dr. Birge: Has it been our experience, General Bryant, in Wisconsin, that the brook trout and rainbow trout would thrive in the same stream?

The President: They have been planted in the same stream, but I think the rainbow trout drift down to the larger streams and the brook trout work up toward the springs. That has been our experience. Our large rainbows are caught in the larger streams like the Willow River.

Mr. Seagle: That has been our experience also. The brook trout seek the upper waters or the colder part of the stream—clear waters. They do not thrive so well in muddy streams. Of course I do not mean to say that muddy streams are suitable for any kind of trout.

Mr. Clark: Speaking of the brook and rainbow trout inhabiting the same stream; there probably is not a better example of it than the Au Sable River in Michigan. Brook trout and rainbow trout are both thoroughly established in that stream. Of course, as you are all well aware, it was formerly the leading grayling stream in that respect in the United States, but now they are nearly all gone. On the Au Sable are found the rainbow trout, and more especially the larger ones, in below the brook trout; but where brook trout fishing is good rainbows will be taken, but they are of the smaller size. The fry of the rainbow trout and brook trout (I am speaking of fry until say July and sometimes later) are found together—I think as late as October, when we were catching parent fish there. We have taken probably as many rainbow trout fry as we did brook trout fry, with the net; so proving that they were right together. It has therefore occurred to me that the larger rainbow trout go down below simply because they are larger. I have seen these large rainbow trout in the spring of the year when they were

spawning, about the middle of March, way up the stream as far as they could go.

In speaking of the planting of fish in the spring: I do not agree with the reader entirely. I think it depends on the age and size of your fish. If you are going to plant fry, plant them before they have been fed at all—in fact plant them just before the sac is gone. If you are going to plant the others, do so after they are partially grown.

Mr. Titcomb: I do not think it is possible today to have in this society the discussions on this question that prevailed a number of years ago and which caused the subject to be tabooed, you might say. I think the fry men and fingerling men are coming together to a certain extent. Now, I have watched for the last twelve years the results from both fry and fingerlings, and I am inclined to agree with Mr. Seagle (I would not say in the spring, just as he does) but, as Mr. Clark says, it depends on the size of the fish; and what fish would be suitable to plant in April in Mr. Seagle's country could not be planted in Vermont, for instance, until July; and we there have begun the planting of fry after they have been fed two months, to thin them out and give us more room; and we then kept up the planting until they were three or four inches long. But the results with the brook trout with us seemed to be better with fingerlings; that is, with these fish that are of the age Mr. Seagle speaks about, than with the fry just after the sac is absorbed, or just before. Then you take another variety, the land-locked salmon. They were planted as fry in Vermont a number of times without any results at all; then we raised them to fingerlings and planted them in September and October in lakes, and got remarkable results. So that while it might be profitable to plant brook trout when they are quite young, my experience has been that in introducing fish into lakes, except into streams that are full of minnows, the fingerlings are far the best and produce the best results. On the other hand, in our Vermont work, we have planted the lake trout as fry just before the sac is absorbed and before they have been fed, with quite as good results as from planting them as fingerlings; and we have planted them in a lake where there were no lake trout, with very remarkable results. I think I spoke about it in the last meeting, where we

had introduced them in one lake, and in three years' time they were having splendid fishing for lake trout. So that we cannot have any hidebound rule about this thing. I like to feed the fish awhile, and I do not think we ought to plant them until they have been fed two months, if we plant them after they have been fed at all.

The President: You do not want to keep them until their spirit of self reliance is all gone.

Mr. Titcomb: I do not think there is much harm keeping them through the fall, but just as good results are obtained from planting them earlier.

The President: Some years ago there was a large surplus of male fish at the Madison hatchery, and we liberated them in a stream which was formerly a good trout stream—quite a number of hundred of them. They were fish reared in ponds and are pretty good size, and we got returns from them after awhile, people caught them, some months after they were deposited in the river, and they were found to be pretty nearly starvd. They did not know how to get a living.

Mr. Titcomb: Those were adult fish?

The President: Yes. Have you ever had any such experience?

A. No, sir.

The President: Those were the reports we got—there were some of them caught, but they were mere shadows, unnourished, starved.

Mr. Titcomb: Was there an abundance of fish in the stream where they were placed?

The President: It had been a good trout stream in its day—naturally—but it had been fished out.

Mr. Titcomb: I should infer that the food was gone, too.

The President: That might seem so, or that they did not adapt themselves to the new environment.

Dr. Tarleton H. Bean: Is it not probable that the reason no rule can be very well established for the distribution of all these trout and the young salmon, is that the differences between them are rather complicated? Our lake trout and land-locked salmon have different spawning habits from the brook trout and the rainbow trout. The young brook trout feed largely at the

surface, whereas the rainbow trout is a bottom feeder, and there are so many different lines of variation arising from the nature of the fish and its habits, that you cannot fix a hard and fast rule, but must be governed by experience and observation of the actual results of planting. It would be of great advantage in point of economy if a man could get rid of the fish early and get the same results as he would obtain if he held them longer before disposing of them; but you must not lose sight of the fact that we are dealing with a pretty big range of territory and habit when we talk of rainbow trout, brook trout, lake trout and land-locked salmon. They are four just as clean-cut and distinct animals as you can very well associate in aquatic life, and I do not believe we will ever arrive at a rule, except the rule of the results which experience demonstrates.

Mr. Clark: Why do you call a rainbow trout a bottom feeder? I never have been able to see a great deal of difference between rainbow and brook trout in that respect. I have seen them both take food from the bottom of the water; but the rainbow trout takes a fly quicker than the brook trout.

Dr. Bean: Because in their wild state, in the region from which they were first obtained for artificial introduction, they were observed to be bottom feeders; that is their original instinct, but fish under domestication are not wild fish and may change their nature. That should be carefully considered.

Mr. Clark: How about the wild state of the rainbow trout?

Dr. Bean: We have no wild native rainbow trout.

Mr. Clark: The ones planted wild.

Dr. Bean: We have none. We have had generation after generation of domesticated fish, fish brought up and taught new tricks.

Mr. Clark: How about the rainbow trout eggs brought here from the Pacific Coast, taken from wild fish and planted in our streams here?

Dr. Bean: How long will it take a fish to learn a new habit?

Mr. Clark: I do not see how they can get new habits when they are hatched from wild eggs and brought from wild streams.

Dr. Bean: Whitefish from Canandaigua Lake learned to eat killifish as quick as brook trout. Domestication works so many

and such sudden changes in fish life that you cannot estimate the effects, except by experience.

Mr. Titcomb: Do not the rainbow trout on the Pacific Coast in their natural habitat take the fly?

Dr. Bean: Yes, but it is known on the Pacific coast as a bottom feeder more than anything else. They may be seen boring right on the bottom, as cod do sometimes, standing on their heads and boring down. But it does not seem to do so here.

To show how domestication may change the habits of a fish, you all know about the experiment in France in the rearing of the big Pacific salmon in fresh water. Two years ago I saw in the aquarium of Paris at the Trocadero, fish hatched from the eighth generation of eggs, the parents of which had been retained in fresh water, and the fish never had access to anything but fresh water. Now, there was a sudden change of habitat and habit, and you would think it inexplicable almost, but they are all good healthy fish, although it is the eighth generation from eggs brought from the Pacific coast. It shows the wonderful influence of domestication in altering habits.

Mr. Clark: I did not question that matter at all. I am well aware that domestication changes fish naturally, but I could not see how that eggs taken from wild fish on the Pacific Coast, brought here, merely hatched on trays, and the fry be planted in a wild stream here, could be said to be in the line of domestication. That was the only point.

The President: There might be a change of environment or external conditions, such as feeding, etc.

Mr. George F. Lane, Silver Lake, Mass.: There are four weeks of their life when you do not feed them, and that in my experience domesticates them considerably.

Mr. H. D. Dean, of Neosho, Mo.: Why do not brook trout survive and thrive with us? They do not, although the rainbow trout do. I cannot take the eggs from the fish raised at the station and get any large percentage of returns from planting them in our streams.

Mr. Clark: I do not know why Mr. Dean would say that they do not thrive there, when I think at his station before he was there, they made quite a spread in the growth of brook

trout in the first year; in fact they had fish nine inches long, when we had some at the same age which were only six inches long.

Mr. Dean: That is so at the station, but you cannot take eggs from those fish and raise any percentage. What I meant was fish that had been put out. We put fish in our springs and they totally disappear.

The President: What is the quality of the water?

Mr. Dean: There is some lime in it, but it is not extraordinarily hard, although rather hard.

Mr. Titcomb: The brook trout won't live in the same waters that you find plenty of rainbow trout in.

Mr. Dean: Yes, that is the point.

Mr. Titcomb: And those waters do not reach a high temperature at any time?

Mr. Dean: The water temperature of almost all springs in Missouri runs from 56 to 58 degrees Fahrenheit—one or two run a little higher.

Mr. Peabody: It is not a question of food?

Mr. Dean: No.

Mr. Titcomb: You may ask why can't we raise rainbow trout in New England. That is the fact with us. Where the temperature of the water gets very low in the winter it seems to debilitate the adult fish, and occasionally they will die just at the season of the year when the ice is forming—it must be colder then than after the ice has covered the spring. The water is full of little sparkling crystals of ice; and while we are able to carry a stock of brood fish we get a very small percentage of eggs, and that is the case where we have obtained eggs from different sources, so that we do not have weak fish from inbreeding; and these rainbows have been introduced in New England and in New York state, and in most cases have disappeared after a short time. I have in mind one stream where rainbow trout were introduced by accident. A gentleman had a private pond and reared some rainbow trout and they got into this stream which was a natural trout stream, but the lower end of it warmed up too much in the summer for speckled trout. These rainbows held their own in that stream for a number of years, but all the best fishing was at the lower end in warm water, but they did

breed there naturally for a time—in fact at one time there were three rainbow trout to one speckled trout—and yet today you perhaps catch in that stream in the course of a season a dozen rainbow trout, but the speckled trout still holds its own. There are lots of places in Vermont where we have introduced rainbow trout, and they have entirely disappeared—just the reverse of Mr. Dean's experience in Missouri.

The President: Do you attribute it to the coldness of the water as the winter comes on?

Mr. Titcomb: I cannot think of anything except the exceedingly low temperatures, and perhaps the conditions in the spring during the spawning season are unfavorable.

Mr. Peabody: We have had the same experience in Wisconsin.

Mr. Dean: The rainbow trout attains an enormous growth in Colorado in the deep lakes.

Mr. Titcomb: With a deep water lake they can get any temperature they want. They do not get anything below 40 degrees in those deep lakes in Colorado, even in the winter. We get down 30 to 40 feet in our Vermont lakes in winter.

Dr. Birge: In Lake Mendota in 80 feet of water in the winter you get a temperature of 1 1-2 degrees Centigrade—say between 34 and 35 Fahrenheit.

Mr. Titcomb: A good deal of the water in these Vermont lakes comes from springs in the lakes. The lakes form from two to two and a half feet of ice on the surface. The temperature in the summer gets up to 80 degrees, but they have the same cool temperature on the bottom.

A FEW POINTS ON THE BLACK BASS—FOR DISCUSSION.

BY J. B. LAMKIN.

In the spring of 1900 the bass at Cold Springs, Ga., Station, commenced spawning on April 13th, in 1901 they were two weeks earlier, beginning on March 31st, while this year, 1902, they commenced March 10th, three weeks earlier than last year and five weeks sooner than the year before. One would naturally suggest that the temperature regulated this difference, but the average March water temperatures for the three years are as follows: 1900, 61.25; 1901, 62.7; 1902, 58.5. Not much attention was paid to the two weeks difference last season, especially as it was noticed that the March water temperature was slightly warmer than the previous year, but this season, with five weeks difference in spawning and with a colder March water temperature of nearly three degrees over that of 1900 it naturally attracts the attention of those interested in Fish Culture.

Another peculiarity in regard to the spawning, is that we have fewer nests per capita each year. In 1900 we had more than twice as many nests as fish in the ponds, and the spawning period extended over several months, running into August. Last year, 1901, although it was impossible to keep a complete record of all nests, as the fish were transferred to larger ponds, it was conceded by all the station force that much less nesting resulted, and that the spawning period covered a shorter time, the fish not spawning any after the middle of July. This year the scarcity of nests has been very noticeable, and the principal spawning was done in a batch, very little having occurred since April. In 1900 we only had twenty-eight breeding fish, in two ponds. In 1901, eighty-seven breeding fish in three ponds. In 1902, 212 breeding fish in five ponds, the majority of them being two and three year olds. In 1900 and 1901 the breeding fish consisted entirely of wild bass, collected from neighboring ponds and streams, a portion having been brought up from Florida. This year two and three year olds, which were raised at the station were added to the brood stock.

These are facts recorded without any comment, and presented to the society for the express purpose of bringing about discussion, in order that some light may be thrown on the subject. Perhaps the same thing occurs at other stations, but if it keeps up at the same ratio, our bass will spawn in mid-winter next season.

DISCUSSION OF MR. LAMKIN'S PAPER.

Mr. Titcomb: I suggest that it be noted on that paper that it relates to the large-mouth bass entirely.

Dr. Birge: I suppose "having twice as many nests" means that the bass spawn twice?

Mr. Stranahan: Yes, sir, and some of them seven times. We had one male that we called Brigham Young, because he was like Brigham in fathering several different nests, and he fathered two broods at the same time, one just hatched and the other swimming up and taking food, some ten days older than the first mentioned.

Mr. Clark: Does that mean twice as many nests as there were males?

Mr. Stranahan: No; it means twice as many as all of them, males and females. Mr. Lamkin was conservative in just saying twice.

Prof. Reighard: It would seem to me that the average monthly temperature could have nothing to do with the time when the fish spawn. It is a few warm days that bring on the spawning, and if you get a few warm days early in March the fish are apt to soften up and spawn, and if that does not happen the next year until April they will not spawn until April. I do not think the average monthly temperature would afford any explanation of the phenomenon.

Mr. Clark: The same is true of our whitefish and lake trout. Temperature is what controls the ripening or spawning of fish, but it is not average temperature. Of course if the water keeps very warm in the fall and the fish do not commence to run, afterward when it cools down a little they come on and immediately begin to spawn, instead of waiting as is usually done. The cold water fish need cold weather to ripen them, and the warm water fish require warm weather.

Prof. Reighard: The males in all cases among these fishes build a nest and the females come in and spawn. With the sunfish and dogfish these females go from one nest to another, so that it is possible for, say, half a dozen females to furnish spawn for a dozen or more nests. Then if cold weather comes on that batch of fish may be hatched, and these same males may make other nests—building again—then a new batch of females comes in and fills, say, another dozen nests. So you may have more nests built than you have male fish, even twice as many, but a single nest does not represent the product of a single female.

Dr. Birge: That is to say, the eggs are not all ripe at once?

Prof. Reighard: That may be.

Dr. Birge: Are not deposited?

Prof. Reighard: Yes, sir—deposited within a day, perhaps, the fish going from one nest to another, scattering these eggs over the nests built by a number of males. I do not know whether that is true of bass, but it is true of sunfish and dogfish. You may in that way get more nests than fish.

Mr. Titcomb: I should like to inquire in connection with that whether this series of nests taken care of by a small number of males necessitated one male having the care of more than one nest at a time. As I understand it, the male takes care of the nest and the eggs, fans them. Now, in the case of Brigham Young, how can he manage so many nests?

Mr. Stranahan: That condition extended over the season of nearly four months. He had only one nest at a time, and perhaps I might state that in the sixth nest that he fathered the eggs were aborted and all died, and we were rather of the opinion that he followed so soon after the brood that he had just left that he had overdone himself. (Laughter).

Mr. Lydell: Prof. Reighard's remarks are correct. The female does not necessarily get rid of all her eggs at one and the same time. The male fish takes her on the nest and when he is through with her she must leave. If she is not finished she must wait for the next fellow. She may have to visit three or four nests before she gets through. That is not true of the finny tribe alone. (Laughter). On several occasions that I know of I have had the bass spawn the second time. The most I ever had was at Cascade Springs. We had nineteen bass. (That was the

experimental stage of the work). Those nineteen bass every one made a nest. There were something like thirty or thirty-five females and we collected the fry from those nests and shipped them, and I packed up my traps and went back to Detroit supposing the season was over with. I had been there nearly a week when I got word from the man at the station to return, that the bass were spawning, and we had nineteen nests just as nice as the others were, nearly as many fish, and nearly two weeks apart. This season I have had bass that have had two broods, and we have one particular bass that has fathered two broods of fish every season in the same place in the same corner of the pond.

The President: Our experience regarding the time of spawning on one occasion surprised us. We were on one of the little lakes at the head waters of the Flambeau, forty-five miles from Lake Superior. The season was unusually cold, and we were there on the 9th of July fishing in those lakes, and our superintendent went to one of the lakes that was notably a bass lake; the small-mouth bass were abundant, and he caught quite a number, but was astonished to find that most of those he caught had not spawned, although they were pregnant with spawn. He seemed to think that unusual for that season of the year; but our season had been very cold and backward there, and that we considered the cause of such late spawning. Do you find it so, Mr. Lydell?

Mr. Lydell: We had some bass spawn this year very late. Prof. Reighard wanted to study the bass when they were spawning, and he had given it up, but after he had returned to Ann Arbor seven or eight more beds were made, and we got quite a few fry from them. I think if I drew my pond down today I would find females that had not spawned. The female requires the attention of the male before spawning, of course.

I have had as many failures in the black bass business as any one. One year at Mill Creek station I had 100 beds with eggs on them, and I did not produce 50,000 fry.

The President: We have had failures in our work. The biggest failure we had was when we made a pen in a shallow lake, where a sort of bed ran up very shallow; we fenced in a lot of bass there by a good fence, and then used your screens. But it went against us some way, and we made a distinct failure.

Mr. Clark: Is it not a fact that the experience of fish culturists has been gained largely through failures? The success of fish culture in the United States at the present time is due to our failures. If we had not had discouragements in the early life of the different classes of fish that we have been working on, I do not think fish culture would be today where it is. I have had failure upon failure all through my life, and still in the main people call me a successful fish culturist.

The President: We have grown wise through a process of elimination.

Mr. Lydell: Our Mill Creek station two years ago was so near a complete failure that the fish commission told me that if they did not have their money in there they would not stay there another minute, but I told them "You had better hang on;" there are lots of things to work out. We have got to keep on studying—don't give it up. I had there that season one hundred and some odd beds; we would have the fish all hatched on the bed and then a thunder storm would come up in the night and the fish would all be dead the next morning, and I would lay it to the thunder storm! The less a man commits himself on the bass question the less he will have to take back in five or six years from now, (laughter) because the conditions in different localities have a great deal to do with the matter.

Mr. Peabody: Which are the easiest for culture, the large-mouth or the small-mouth bass?

Mr. Lydell: In my experience I have not found any very great difference. I think you have got to be a great deal more careful in sorting your small-mouth bass than you have your large-mouth bass. On one occasion we just dumped the large-mouth bass promiscuously into the ponds, and only got five beds. Therefore, I concluded that we had five females in the lot; but they do not seem to trouble one another like the small-mouth bass. We had one year a lot of small-mouth about twelve inches long, and they were all males. They seemed to band together like a lot of outlaws. They would go around the large pond, come to a pair of bass spawning, and all dive into that nest, and I have seen ten or fifteen of them just standing on their heads and rooting the whole thing up; and I drew the pond down in the spawning season and took all those fish out and threw them

on the bank, fifty or sixty of them, and after that I got a few nice beds of bass that same season.

Mr. Dean: In relation to the time of the spawning of the bass, I would like to know if anyone has thought that possibly the age of the bass might make a difference in the time of spawning. I did not know but Mr. Lankin might find that one reason. I know the young rock bass spawn later than the older ones.

Mr. Lamkin: I don't know.

DISCOURAGEMENTS IN BASS CULTURE.

BY H. D. DEAN.

This is a wide subject, too wide for the limited time at my disposal, but I will endeavor to present a few facts which have occurred during my five years experience at a bass station.

One of the greatest trials in fish culture, especially bass culture, is the fact that it takes a year to try an experiment, consequently experience is acquired slowly and, while we are trying our theories, the years slip by.

One year we may have a good crop of bass and the next season, under the same conditions, so far as we know, we have almost a failure.

At the Neosho Station we have tried many schemes that seemed feasible under the conditions existing at that station. At first the breeders were placed in the ponds in March; the ponds were drawn in July and the young fish transferred to hatching troughs; the fish were taught to take artificial food and thus carried until distribution which usually commenced about October 1st. Afterwards the troughs were placed outside where they could be supplied with water from one of the ponds at a temperature of from 65 to 77. This plan worked very well, but the young fish did not grow very fast and it entailed a large amount of work in feeding and caring for the fish. Again some of the small fish about one-half inch long, were brought to the hatchery and taught to take food and a good per centum raised, but they were very small and it was concluded that it would not be practical to raise large numbers in this manner.

One year about six thousand fry three quarters of an inch long, were seined from the spawning pond and transferred to a small pond well filled with vegetable and animal life; two months later this pond was drawn and a little over eight hundred fine bass taken out. This result was too small to be of practical value.

Another year, two of the ponds were fitted with partitions so the breeders could be placed in a small portion of the pond for

spawning and at schooling time the young could pass through the screens into the main body of the pond. The water was too low to give this plan a fair trial and the only thing learned was, that the young fry were much larger and fewer in number than usual.

This year the ponds were drawn in June, in hopes that more fish could be saved. Over seven thousand were taken from one pond and placed in another pond which was in good condition and after thirty-six days this pond was drawn and but 2,650 fish found. Some of these were very large—one was measured and found to be six and one-half inches long and weighed two and one-half ounces.

There are several other things that vitally affect the raising of bass, vegetation, natural food, water temperature, supply, etc. Sometimes it seems impossible to get vegetation to grow in a pond and unless there is a good growth of plant life, there will be no fish; that is, no great number and if there is a good growth of water plants, then the prospects for fish are much better.

There are plenty of crayfish in the ponds at Neosho and a fair quantity of other natural food. We also put in top-minnows and try to keep a good stock of food for the fish, but so far have failed to raise fingerling bass in the numbers desired.

One thing that has hindered the work, has been the fact that we have been almost constantly working at the ponds and grounds to get them in shape for good work and we are now getting them in that condition. The water supply, also, has been deficient at times and that has affected the work.

I have always been of the opinion, that the sooner the young fish could be taken from the ponds and placed in small nursery pools or troughs, where they can be constantly under supervision and easily kept sorted, the more fish can be raised. Mr. Leary of the Texas station, is working on this line with excellent results. This plan means that there must be plenty of natural food for the young fry until they can be taught to take the artificial food.

In fact the greatest failure in the raising of bass, is the failure to raise natural food in sufficient quantities at the right time, for the young fry. There is never any difficulty in getting large numbers of eggs and fry, and if the fish were distributed when they were schooling or even when one inch long, there

would not be much difficulty in sending them out in large numbers. But the great problem is to prevent their eating each other before they are large enough to take artificial food.

If all the breeders in one pond would spawn at one time so the young would be practically all one size, then the danger of cannabalism would be much lessened. A superintendent of one of the state commissions told me that he had accomplished this by holding the breeders in spring water, at even temperature, all winter, then placing them in the breeding ponds ten days or two weeks before spawning, and they all spawned at once. Well this sounded alluring and I experimented with a few fish, with the result of another failure to add to the list—these fish did not spawn at all that year. But "Hope springs eternal" and next year we hope to raise a large crop of large mouth black bass.

LIST OF MEMBERS.

ACTIVE.

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

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

The President of the United States.

The Governors of the Several States.

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

CORRESPONDING.

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

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

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

RECAPITULATION.

Active	332
Honorary	54
Corresponding	24
Total membership	410

CONSTITUTION.

(As amended to date).

ARTICLE I.

NAME AND OBJECTS.

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

ARTICLE II.

MEMBERS.

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

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

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office

until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

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

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussions of same.

(Note—a. In the reading of papers preference shall be given to members present.
b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society).

7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

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