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PROCEEDINGS.

American Fisheries Society.

1898.

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NATIONAL MUSEUM

MINUTES

OF THE

AMERICAN

FISHERIES SOCIETY

AT ITS

TWENTY-SEVENTH ANNUAL MEETING

HELD AT THE HOTEL MILLARD, OMAHA, NEBRASKA,
ON THE 20TH, 21ST AND 22ND DAYS
OF JULY, 1898.

SPEAKER PRINTING COMPANY,
DETROIT.

OFFICERS FOR 1898-99.

President—George F. Peabody, Appleton, Wis.
Vice-President—William H. Bowman, Rochester, New York.
Recording Secretary—Herschel Whitaker, Detroit, Mich.
Corresponding Secretary—J. E. Gunckel, Toledo, O.
Treasurer—L. D. Huntington, New Rochelle, New York.

EXECUTIVE COMMITTEE.

J. A. Dale, York, Pa.
E. E. Bryant, Madison, Wis.
J. J. Stranahan, Put-in-Bay, O.
F. N. Clark, Northville, Mich.
J. W. Titcomb, St. Johnsbury, Vt.
W. L. May, Omaha, Neb.
Dr. J. A. Henshall, Bozeman, Mont.

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PROCEEDINGS OF TWENTY-SEVENTH ANNUAL MEETING OF AMERICAN FISHERIES SOCIETY AT THE HOTEL MILLARD, OMAHA, NEB., JULY 20, 21 AND 22, 1898.

FIRST DAY'S PROCEEDINGS.

MORNING SESSION.

At 10 o'clock a. m., July 20th, the Society was called to order by the President, Hon. W. L. May.

The following members were present:

Geo. F. Peabody, Wisconsin; Seymour Bower, Michigan; J. J. Stranahan, Ohio; J. E. Gunckel, Ohio; F. N. Clark, Michigan; James Nevin, Wisconsin; E. A. Birge, Wisconsin; Calvin Spencley, Wisconsin; W. L. May, Nebraska; W. J. O'Brien, Nebraska; Herschel Whitaker, Michigan; J. A. Dale, Pennsylvania.

The president announced that owing to a lack of time he had not prepared any formal welcoming address, and that he took pleasure in introducing Mr. James H. Adams, who would welcome the society on behalf of the City of Omaha.

Mr. James H. Adams, the secretary of the Mayor of Omaha, in well-chosen words extended a hearty welcome to the members, offering them every opportunity that could be afforded by the city officials and the Mayor's office to see the city and its industries and attractions.

Mr. Spencley responded on behalf of the Society in fitting words, expressing thanks for the courtesies extended, with a promise that the members would avail themselves of the opportunities offered.

The Treasurer being absent, Mr. Peabody was elected Treasurer pro tem.

The President announced that the next business in order was the presentation of candidates for membership, and the following were proposed:

John D. McLeod, Milwaukee, Wis.; S. L. Griffith, Danby, Vt.; A. C. Rosenburg, Kalamazoo, Mich.; George M. Brown, Saginaw, Mich.; Professor H. C. Bumpus, Providence, R. I.; George L. Alexander, Grayling, Mich.; Professor J. E. Reighard, Ann Arbor, Mich.; E. A. Tulian, Leadville, Col.; John G. Ruge, Apalachicola, Fla.; G. C. Leach, St. Louis, Mo.; H. A. Morgan, Baton Rouge, La.; Professor Henry B. Ward, Lincoln, Neb.; R. S. Oberfelder, Sidney, Neb.; W. W. Barrett, Church's Ferry, N. D.

The President appointed Mr. C. Spencley to act with Mr Dale and Mr. Clark, members of the executive committee, and the names of the candidates were referred to the committee for action.

After consultation the executive committee, through its chairman, Mr. Dale, reported favorably upon the admission of the candidates for admission.

The report of the committee was accepted and adopted, and the applicants declared duly elected.

The President: The next business in order is the reports of officers. I wish to say that I had not supposed it was customary for the President to present any formal report, and therefore have no report to present. We will listen to the report of the Secretary.

The Secretary reported as follows:

To the American Fisheries Society:

Gentlemen: I beg leave to submit the following report for the past year:

Immediately after the close of the last meeting I had two copies of the stenographer's minutes prepared, one of which I retained, the other was separated, the different portions being sent to the members participating in the discussion, for correction, with a printed slip attached urging immediate revision and return. Prompt responses were received, and this action on the part of members greatly facilitated the work of the Secretary, enabling me to put the proceedings into the hands of members at the earliest date by far since I have had an acquaintance with the Society.

Bids were solicited from four responsible firms for the printing of the report, and the lowest bid was accepted, being much below any others received. Not only was the price per thousand ems lower, but the quantity of matter set to the page was greater, the type being considerably smaller than that used in prior reports.

During the year I have sent out to members personal letters requesting their co-operation in securing candidates for membership. While this did not meet with the general hearty response looked for, something was done, and I wish specially to acknowledge the assistance of the Hon. J. W. Titcomb for the interest taken by him in this effort. He has secured four applications, and I think has others in view. This work was done without any special effort on his part by simply keeping the matter in mind. I have secured seven applications, and would suggest to members the advisability of doing a little of this work in the future, which will result in bringing in persons who, even if they do not attend, are interested in our work and would be quite willing to take membership for the purpose of getting the reports of the Society.

The inducement held out to persons to join used by Mr. Titcomb and myself was that a person putting in his application during the interim between meetings would receive the report of the last meeting gratis, and his application not coming in to be acted upon until the next meeting he was thus practically given the benefit of a two years' membership for one year's fee. I know no better use to be made of the reports on hand, after the distribution has been made to members.

Following out the suggestion of the society at the last meeting, in May of this year I prepared and sent out a circular to the membership, and to others likely to be interested in our work, inviting their attention to the Omaha meeting, and asking them to contribute papers on some subject of interest to the Society. The result was very encouraging, as is evidenced by the excellent program of papers prepared for this meeting, which is in your hands. I think the preparation of a program in advance is a good idea and has fulfilled the expectations of those who suggested it, and in my opinion should be followed out every year.

Following the issuing of the program, 175 postal cards with return reply attached were sent out to members asking them to notify me whether they would attend the meeting, so some arrangement could be made for their comfort in the way of transportation, not otherwise to be secured.

The work of this office in the way of correspondence has been quite voluminous, something like three hundred personal letters having been received and answered. This, in connection with the preparation of the report and the issuing of circulars and program, has called for the expenditure of considerable time, but if it shall result in added interest in our work and a successful meeting it has been worth what it cost in expenditure of time.

On the recommendation of my predecessor in office, the Society directed an official seal be procured, which I did. I can see no use to which the seal may be put, but I have carried out the direction of the Society in this regard.

In making up the report last year I found that the nominating committee, in its report, which was unanimously adopted, had made a mistake in putting on the executive committee a gentleman who was not a member of the Society. This fact was overlooked at the time of the adoption of the report. While the gentleman named would have been a most desirable member of that committee, considering the fact above stated, I took the liberty of substituting in his stead the name of Mr. H. A. Sherwin, who was present at the meeting, and who takes an active interest in our success.

After issuing the report of the last meeting my attention was called to the omission from the list of active members of the name of Mr. Carl Thompson. This was a mistake, the gentleman having paid his dues and being in good standing as a member. His name was included in the report sent by me to the Treasurer as among those who had paid dues. How the error occurred is unexplainable, but it is one of those annoying mistakes which will occur. His name should be placed in the next list published. A letter was written Mr. Thompson apologizing for the mistake.

Following out the action taken at the last meeting, copies of proceedings were only sent to those entitled to them on account of membership. Complaint as to this has arisen only in one instance to my knowledge. Mr. C. B. Reynolds, the proprietor of Forest and Stream withdrew from membership in the Society at the last meeting. Soon after the distribution of the report Forest and Stream contained an article commenting on the action of the Society in confining the distribution of its reports to members. The article seemed to me to require a reply, and the following was sent to that paper and was printed:

Detroit, Mich., Oct. 11, 1897.

Editor Forest and Stream:

My attention has been called to an item on the first page of your issue of October 9th stating that you had failed to receive a report of the American Fisheries Society, and commenting on the action of the Society in restricting the distribution of its reports to its members. While the Society did so restrict the distribution, I knew it was not its intention to exclude the sporting press, and, therefore, immediately on its issue I mailed to Forest and Stream and other kindred publications a copy. If your copy was not received it must have been through some fault of the mails. I know the copies mailed to some of the other papers were received and I presumed you had received yours. There was no intention of denying Forest and Stream a copy. I wish you would give this letter publication in order that neither the Society nor myself may be misunderstood in this matter.

HERSCHEL WHITAKER.

Mr. Fred. Mather also wrote an article on this subject to that paper, which was published before the one written by me, given above. Mr. Mather took the ground, which is the true one, and which appealed to him after a long connection with this Society as its Secretary, that the possession of the reports should be one of the strongest inducements for persons interested in our work to join is they wished to enjoy its benefits and privileges.

The report of the Secretary was accepted and ordered printed.

The report of the Treasurer was then submitted, as follows:

New Rochelle, N. Y., July 12, 1898.

To the American Fisheries Society:

Gentlemen: I herewith submit my report as Treasurer from June 15, 1897, to July 10, 1898:

By my report rendered June 15, 1897, the balance in hands of Treasurer was		$327 77
Dues since collected amount to $348, as follows:		
1894 dues	$6 00	
1895 dues	6 00	
1896 dues	6 00	
1897 dues	330 00	
		348 00
		$675 77
Disbursements		274 51

Leaving a balance in hands of Treasurer at this date of. $401 26.

The membership is about the same as at last report, eleven new members being elected at the last meeting in June, 1897. Lost by death, 1, Mr. David G. Hackney, of Ft. Plain, N. Y. By resignation, 4, Dr. T. H. Bean, Frank Foggin, R. M. Mackay and H. H. Lyman. By request to have their names dropped from list of membership, 3, Edward Thompson, J. E. Ashe, C. E. Griffith. One who claims he is not a member, A. A. Hyman. Not to be found, S. H. Palmer. Dropped for non-payment of initiation fee, Dr. A. W. Hoyt. For non-payment of dues under constitutional provision, 4. C. F. Chaberlayne, elected in 1894 and paid '94 dues only. G. W. Upton, elected in 1893 and paid 1893 dues only. W. R. Huntington, elected in 1893, paid 1893 dues only. J. F. Offensend, elected in 1892, paid only 1892 and 1893 dues, and one who requests his name to be dropped for non-payment of dues, Mr. C. W. Smiley, elected in 1894 and paid only 1894 and 1895 dues. Total dropped and resigned, 16.

There remains a trifle larger amount of dues uncollected than at the close of last year, although bills with special requests were sent to all members in arrears on August 20th, October 20th and December 20th, 1897, and on March 20th and June 10th, 1898. The request sent December 20th contained a return stamped envelope.

I submit this as supplementary to my regular report, as general information for those present at the twenty-seventh annual meeting. Yours truly,

L. D. HUNTINGTON, Treasurer.

American Fisheries Society in account with L. D. Huntington, Treasurer:

RECEIPTS.

June, 1897, balance in hands of Treasurer......	$327 77	
Received at hands of H. Whitaker, Secretary, dues collected at meeting held at Detroit, June, 1897, 1894 dues $6, 1895 dues, $6, 1896 dues $3, 1897 dues $69........................	84 00	
Dues received by Treasurer direct from members, 1894 dues 0, 1895 dues 0, 1896 dues $3, 1897 dues $261	264 00	
		$675 77

DISBURSEMENTS.

June, 1897, account of Treasurer direct, typewriting 65c, express 25c......................	90
August 20, 1897, account of Treasurer direct, postage stamps............................	4 12
September, 1897, account of Treasurer direct, printing and stationery......................	3 25

October, 20, 1897, account of Treasurer direct, postage stamps	2 34	
December 20, 1897, account of Treasurer direct, typewriting 75 letters	2 50	
December 20, 1897, account of Treasurer direct, postage stamps	3 40	
January, 1898, account of Treasurer direct, printing and stationery	1 50	
January, 1898, account of Treasurer direct, postage on reports	56	
March, 1898, account of Treasurer direct, printing stationery	1 50	
March, 1898, account of Treasurer direct, postage stamps	1 40	
June 10, account of Treasurer direct, postage stamps	86	
July 10, account of Treasurer direct, postage stamps	30	
August 23, 1897, account of Treasurer direct, Speaker Printing Co., printing proceedings	113 95	
October, 1897, account of Treasurer direct, L. B. Case, stenographer at Detroit meeting	81 80	
April, 1898, account A. N. Cheney, 1896, Secretary, \$3.70, \$5.20	8 90	
Account H. Whitaker, Secretary, as per his account, postage	18 95	
Account H. Whitaker, Secretary, as per his account, expressage	8 68	
Account H. Whitaker, Secretary, as per his account, printing and stationery	15 10	
Account H. Whitaker, Secretary, as per his account, official seal	4 50	
		274 51

Balance in hands of Treasurer, July 10, 1898........\$401 26

L. D. HUNTINGTON, Treasurer.

New Rochelle, July 12, 1898.

A recess was then taken to afternoon.

AFTERNOON SESSION.

Mr. Peabody in the chair.

Secretary Whitaker: There are two items of business here that I think had better be attended to before we proceed with the regular program.

I have invitations from different parties in regard to the meeting of the Society for next year.

Secretary Whitaker then read a letter from David S. Rose, Mayor of Milwaukee, and also a telegram sent by the Citizens' Business League of Milwaukee to the President of this Society; also a letter from John W. Titcomb, President of the Vermont Fish Commission; also a letter from A. S. Hastings, Mayor of Niagara Falls, N. Y.; also a letter from the President of the State Park of Niagara Falls, inviting the Society to meet at that place.

I think it would be well to appoint a committee to select the place of meeting for next year, and I move that the chair appoint a committee of three to decide upon the next place of meeting.

The motion was duly seconded and unanimously carried.

The Chair: I will name that committee later on.

Secretary Whitaker: I move that the invitations read be received placed on file and referred to the committee.

The motion was duly seconded and carried.

President W. L. May then resumed the chair.

Secretary Whitaker: I have a communication here from Mr. Emilie Cacheux. I have had a translation made, which is as follows:

The Second International Congress of Commercial Fisheries and Oysterculture, under the auspices of the Ministers of Commerce, of Public Instruction, of the Colonies and of the Marine and Agriculture, in conjunction with the Chamber of Commerce of the City of Dieppe, from the 2d to the 6th of September, 1898.

Office of the General Secretary,
25 Quai St. Michel, July 6th, 1898.

To the Secretary of the American Fisheries Society:

I have the honor of addressing you by this mail a pamphlet of our society and a program of the International Congress of Fisheries, which meets at Dieppe from the 2d to the 6th of September next.

We shall be very happy to see your society represented at this Congress, whose prime object will be to effect a preparation for the meeting to be held at Paris in 1900 of the Exposition Universelle.

You are undoubtedly aware that there will be held an International Congress of Fisheries at Bergen, Norway, July 18th to 21st. To avoid a conflict of the several International Congresses it will be necessary to form a permanent committee having charge of the arrangements for this meeting, and we count upon that being done at Dieppe. Can you not bring this matter up at the meeting at Omaha, and ask the several societies that will be there represented to designate some persons to represent them upon this permanent committee for the International Congress? We shall complete the committee at the Dieppe Congress, and will exchange ideas through our respective bulletins.

Accept, my dear sir, the assurances of my highest consideration.

EMILIE CACHEUX.

Mr. Peabody: I move that Professor Birge be appointed to represent the Society in response to the invitation just read, and attend if he can.

Professor Birge: I suggest that the matter be referred to the executive committee that will be appointed at this meeting. Let them correspond and see if they cannot find some of the Eastern men who are interested in the Society and who will consent to represent the Society.

Mr. Clark: A member of this Society, Captain Collins, is probably in Bergen now.

Mr. Whitaker: Captain Collins is not a member. I suggest that the matter be held in abeyance until some future time at this session.

The Chair: Very well, if there is no objection it will be so ordered.

The President announced the following committee on place of next meeting: Mr. Herschel Whitaker, of Michigan; Mr. Calvin Spencley, of Wisconsin, and Mr. J. A. Dale, of Pennsylvania.

President: Is the Auditing Committee ready to report?

Mr. Spencley:, chairman of the Auditing Committee, submitted the following:

To the American Fisheries Society:

Your committee, appointed to audit the report of the Treasurer of the society, beg leave to report:

That they have carefully examined the same and the accompanying vouchers and found the same correct in all respects and they find that the balance in the hands of the Treasurer at the date of said report was the sum of $401.26.

They further recommend that the society tender to the Treasurer a vote of thanks for the great zeal he has used in collecting the dues from the members of the society, which has resulted in the present very satisfactory state of your society's finances.

CALVERT SPENCLEY,
JAS. A. DALE,
J. E. GUNCKEL.

President May: What is your pleasure as to the report of that committee?

Mr. Clark: I move you that the report of the committee be accepted and adopted.

The motion was seconded and unanimously carried.

Mr. Dale: I beg leave to submit the following majority report of the committee on the reduction of dues:

A discussion before the Auditing Committee in regard to the reduction of the dues of the society was participated in by a large number of the members. The majority of the Auditing Committee beg leave to report that they believe a reduction at this date of the dues to $2.00 a year would be sufficient to sustain the financial work of the society and add greatly to its membership.

The committee would also suggest that a certificate of membership in the association be procured.

JAS. A. DALE,
J. E. GUNCKEL.

Mr. Spencley submitted the following minority report:

To the American Fisheries Society:

As a member of your committee, to whom was referred the question of the advisability of reducing the dues for membership and the amount of annual dues, I beg leave to make a minority report.

I am satisfied, after a careful consideration of all that was said before the committee on the subject, that it would be for the interests of the society to reduce such membership fee and annual dues to the sum of $1.00.

I believe that this would very greatly add to the membership of the society and the attendance at its meetings and that its influence and importance would be thereby greatly increased. I am satisfied that the addition to our membership would be so great that the annual dues of $1.00 would be ample to provide for all the expenses of the society, and would, in fact, produce a greater revenue than the present dues of $3.00 or even of the $2.00 fee recommended by the majority of the committee.

All of which is respectfully submitted

CALVERT SPENCLEY.

Mr. Spencley: I beg leave to move its adoption.

Mr. Peabody: I will second the motion.

Prof. Birge: I move that both reports be laid on the table and be made a special order for the meeting of 1899.

Mr. Spencley: I hope that motion will not be pressed by Prof. Birge. I think that is a matter that should be considered now. If Prof. Birge's motion prevails it will simply cut off all debate.

Prof. Birge: I will withdraw the motion if you desire to discuss it.

Mr. Nevin then seconded the motion to adopt the minority report.

Mr. Stranahan: What are we to understand as to the powers we have; have we the power to change these fees or dues with our present membership?

Secretary Whitaker then read the constitution as to the point in question.

President May: Under the constitution we have the right to change the amount of dues, and fifteen members being present two-thirds will be sufficient to make the change.

Mr. Clark: What is the question before us?

President May: The question before the house is on the adoption of the minority report.

Mr. Clark: I move as an amendment that the minority report be laid upon the table and that a committee of five members be appointed to report upon this matter at our meeting in 1899.

Mr. Whitaker: I second Mr. Clark's amendment.

President May: The amendment is in order. The amendment is to lay on the table; that does not admit of debate.

The motion was put by President May and as the vote seemed to be in doubt, a division of the house was called for. A rising vote was taken, resulting in the amendment being lost.

The President: The question now occurs on the original motion, which is on the adoption of the minority report.

Mr. Spencley then discussed the minority report, advocating its adoption.

Mr. Whitaker opposed the adoption of the minority report.

Mr. Clark: I wish to be on record in this matter in the report. I desire to say that I am opposed to the reduction of the dues at this time and the motion that I made to lay this minority report upon the table and appointing a committee would probably accomplish the same thing. I want to say that I want to have other members have some voice. I want to be put on record as opposing the reduction of the dues.

President May: Are there any further remarks? If not, we will call the roll on the adoption of the minority report.

A roll call was had, resulting in fifteen votes being cast; ten voting in the affirmative and five in the negative.

Two-thirds having voted affirmatively, the minority report was declared adopted and the dues were reduced to $1.00 per year.

Mr. Peabody: I understand this refers to next year.

Mr. Spencley: That is a proper question to settle, whether it should apply to the present year or the future. It is not mentioned in the report.

Mr. Peabody: I would move that this do not apply to the dues for the past year, but to membership dues for the coming year.

Mr. Clark: It occurs to me, now that we have voted on this, that I am very much inclined to think that it should apply at once. I move to amend, that this resolution just passed shall apply to all members who shall join this association to-day or during this meeting and to all dues that are due to-day.

The motion was duly seconded and carried.

Mr. Whitaker: I move you, in order to keep the finances of the society straight, that the Secretary be directed to return to the persons whose applications with full fee are in to-day, the difference between the one dollar and three dollar fee for dues.

The motion was duly seconded and unanimously carried, and it was so ordered.

Mr. Dale: I move you that the chair appoint a committee of ten members on the increase of the society, and that the gentlemen who moved the adoption of this report to reduce the fee to one dollar, be the members of that committee.

The motion was seconded.

President May: It has been moved and seconded that a committee of ten to secure new memberships be appointed by the chair.

Mr. Spensley: I move to amend; that all members of the society be appointed on that committee to endeavor to get new members.

The amendment was duly seconded and unanimously carried.

Mr. Gunckel: If it is the proper time to make a motion that a committee be appointed to select officers for the coming year, I would make a motion that the chair appoint a committee of five members for that purpose.

The motion was duly seconded and carried.

President May: I will announce that committee later.

Secretary Whitaker: The first paper in order on the program, is a paper by Mr. James Nevin, Superintendent of the Wisconsin Fish Commission.

Mr. Nevin read the following paper:

ARTIFICIAL PROPAGATION VERSUS A CLOSE SEASON FOR THE GREAT LAKES.

Inasmuch as some of the states have passed laws making a close season for fishing on the Great Lakes during the spawning season of certain kinds of fish, expecting thereby to accomplish greater results in increasing the supply of fish thus protected than is derived from artificial propagation, I am impelled to devote my paper, for the most part, to an expression of my views of the relative value of the two methods of increasing the supply of valuable food fishes in those lakes. It is true that both methods may be employed in the Great Lakes at the same time, and perhaps with good results; but if both are employed at the same time in the same waters, if the desired increase of fish be forthcoming, the question will then arise as to which method we are to attribute the results; and in consequence it may end in the abandonment of one method for the other, and possibly in the uncertainty of the case, the abandonment of the method which has done the most to bring to us the desired increase of fish. For this reason, it seems apropos at this time, that a discussion and investigation of both methods be made here and now relative to the results which have been obtained from both methods as employed in the past at different points, together with a presentation of the arguments for and against both methods. We have considerable knowledge of both methods and know something of the apparent results from each. We have the experience of practical men and the conclusions they have drawn, pro and con, which we may discuss here at this time; and thus place on the records of the American Fisheries Society our views and our knowledge of these matters; which may be of benefit or at least of interest to those who take up the work of fish culture after it has passed from our hands and "Old Time" has applied his scythe to the line which binds us to our vocation.

Personally I have been on the various spawning grounds of the whole chain of Great Lakes from the Gulf of St. Lawrence to Lake Superior during the spawning seasons; and I have many times watched the salmon trout, whitefish and wall-eyed pike spawn in their natural way; and I am convinced that only a very small percentage of the eggs so deposited are fertilized. If as large a number of eggs as is claimed by some people are fertilized in the natural process, I inquire, what becomes of the fish after they are hatched? When we come to take into consideration the number of eggs that each female whitefish, lake trout and wall-eyed pike will produce, we may well make this inquiry. A four-pound whitefish will produce 50,000 eggs; a six-pound lake trout, 8,000, and a five-pound wall-eyed pike about 100,000. These figures, considered in connection with the vast number of fish of various kinds in the lakes, require no backing with argument to justify the question, "What becomes of the fish after they are hatched?"

Some years ago I had an interesting and profitable experience watching whitefish spawn in ponds on the Detroit river. The female fish would come to the top of the water and throw her eggs whether there was a male fish in her vicinity or not. To me it seems impossible that the male fish can fertilize one egg in a million that are thrown off by the female, when I know that it is absolutely necessary that the milt come in contact with the eggs immediately after they are thrown off by the female and while the micropyle is open to receive it; and considering the small amount of milt possessed by the male and the manner in which it is thrown off into a large body of water.

Another circumstance that confirms me in my belief as to the small number of eggs fertilized by the natural process is the order in which the male and female fish come on to their spawning beds. In the Great Lakes, the first run of fish in spawning time is composed almost exclusively of male fish. They are followed in a few days by the females; and in taking spawn from this second run of fish, we find that seven-tenths of the fish taken are females; and it is a difficult matter to get enough male fish to fertilize the eggs taken. It frequently occurs that pails full of eggs are thrown overboard because enough male fish cannot be procured to impregnate them. A few days after the run of females has passed off, a run of small male fish comes on. I have heard many people say that this run of male fish will fecundate the eggs of the earlier run of females. But those of us who have had experience in practical work know that the eggs cannot be fertilized after they have left the fish two hours. However, assuming that a part of the eggs become fertilized, they must of necessity be lodged among those which are not fertilized and consequently, the fungus growth, with which all fish culturists are familiar, spreads over the entire mass, and the percentage that hatches must be very small. The only way that suggests itself to me that will ever enable us to form an accurate idea or obtain positive knowledge of the number of whitefish eggs impregnated naturally is to have a diver go down on the reefs and bars just after the fish get done spawning, and gather up a few gallons of eggs, which may be placed in a hatchery and the results noted.

Last fall I spent three half-days on a trout stream and examined numerous spawning beds at the time the trout were spawning in the stream. I had such apparatus as I thought necessary to obtain any eggs that might be on the beds, but we did not find a single egg in any nest that we examined. I presume the eggs had been devoured by the trout as fast as deposited. My purpose was to find the percentage of trout eggs impregnated by the natural process. I shall follow up this work again this fall and hope for better results.

There are very few good trout streams in which less than one thousand trout spawn naturally each year. These trout should average at least two hundred eggs each, making two hundred thousand eggs deposited in the stream each year. If five thousand trout are hatched and come to maturity, this should certainly be enough to keep the stream well stocked, under the protection of a close season eight months in the year. But our experience teaches us that it does not matter how well a stream is stocked, if it is fished for two or three seasons, fry must be supplied from the hatcheries if it is to continue to produce good fishing.

I have done some figuring on my own account to get at the number of whitefish eggs, deposited naturally, required to produce one mature fish weighing two and one-half pounds. I have taken the whole number of pounds whitefish caught on the chain of Great Lakes, that is, Lakes Superior, Huron, Michigan, St. Clair, Georgian Bay and Lake Erie (not including fish taken from Lake Erie in Pennsylvania and Ohio waters), which in 1896 was 8,223,900 pounds. Estimating that each fish taken weighed two and one-half pounds, we find that 3,289,560 whitefish were caught. Estimating that there were left in the water three times as many fish as were taken out and that six-thirteenths of the fish are females (I believe that most practical fishermen will agree that these estimates are low), we find that there were 4,554,747 female fish producing eggs. Allowing an average of 30,000 eggs for each female, we find that 136,642,220,000 eggs were deposited naturally and produced only 3,289,560 mature fish. Thus we find that of 41,568 eggs deposited naturally, only one fish comes to maturity. Of course, many things must be taken into consideration in making these estimates; and at best the estimates as well as the results obtained are barely approximate. Yet it gives us something of an idea of the vast number of eggs that must be deposited in the natural process to produce a single mature fish. In making these figures no account is made of the millions of whitefish fry annually planted by the several states and the United States.

Thus after spending twenty-five years in the work of fish culture and propagation, I cannot but conclude that an enormous loss of fish of nearly all species occurs in the egg stage, because the eggs deposited by the female are not fertilized. The result is, our streams and lakes become depleted of fish within a short time after men with modern fishing apparatus begin to take fish from the waters for food. Nature's provisions for the survival and increase of the several species of fish are not adequate. To rectify this apparent error in nature's laws, we have resorted to artificial propagation with gratifying results. That we still have much to learn in this work, we all agree. But at the same time, I believe that all fish culturists and those whose knowledge of the subject qualifies them to speak intelligently of it, will admit the complete success of artificial propagation with many species of fish. I refer particularly to the stocking of our Wisconsin streams, once barren, with brook and rainbow trout; and the planting of shad in the rivers of the Atlantic and Pacific coasts, facts with which we are all familiar. A few years ago shad were unknown on the Pacific coast. A few thousand fry were taken from New York State and planted there. To-day shad are as plentiful on the Pacific coast as on the Atlantic. The planting of salmon fry in the rivers of the Pacific coast has done wonders in the way of increasing the salmon. Many other species have been made to increase and multiply very rapidly.

That whitefish eggs can be hatched artificially in large numbers, there is no question; and I hold that given suitable planting grounds on which the proper food is found in sufficient quantities, and protection to the small partly-grown whitefish until they come to maturity, there is no reason why we should not have the same success in maintaining the supply of these fish as we have had with others.

Our experience with the inland lake whitefish in Wisconsin has demonstrated this to our satisfaction. In 1889 and 1890, a large number of inland lake whitefish fry was planted in Chequamegon Bay. The eggs from which these fish were hatched were taken from Lake Mendota, at Madison. In about three years after the fry was planted, the fish began to show up to good advantage and are now taken by tons in Lake Superior. This seems to us good evidence of what can be done by artificial propagation, where the waters into which the fish are introduced are naturally adapted to them.

Relative to the operation of laws providing for a close season on the Great Lakes, I call attention to the Province of Ontario, Dominion of Canada. The Province of Ontario has had a close season for the fish of the Great Lakes for the past twenty-five years. The fish protective laws are much more rigidly enforced on the Canadian side of the Great Lakes than on our side. The fishermen operate under a license system. The number of boats and nets that may be used is limited. The number of pound nets which may be set in a string, the number of strings in a locality, the size of the mesh, and the manner in which they may be set in channels, etc., are all carefully prescribed. Each fisherman is limited to certain specified grounds, and he is not permitted to fish on any other grounds than those allotted him; nor are other fishermen permitted to fish on the territory assigned to him.

This feature of the law operates very decidedly to protect the fish in many instances where the fish run in large numbers to certain localities at certain times of the season or year. In such instances, the fisherman having the right to fish in the locality where the run is large, can only fish the number of nets allowed him in his license, and his neighbors are not permitted to set their nets on his grounds; and many fish which would be taken if a larger number of nets were set, escape. To illustrate this point, I have seen as many as eight tugs fishing on one small reef, and occupying so small a territory that the nets of the different tugs were crossed and recrossed several times.

Recently I have gone through the several annual reports of the Fisheries Department of the Dominion of Canada to find the results of their close season for twenty-five years on the catch of whitefish for the Province of Ontario from Lakes Superior, Huron, Erie, St. Claire, Georgian Bay and the Detroit River. I have compared the catch of whitefish in the Province of Ontario with the catch from the same waters in the State of Michigan, which has less coast line than Ontario and has not had a close season until this year.

From the last Biennial Report of the Commissioners of Fisheries of the State of Michigan, I learn that from the year 1891 to 1895 there was a decrease of 58 6-10% in the catch of whitefish in that State. In the Province of Ontario, I find that during the same period there was a decrease of 58 5-10% in the catch of whitefish. This is approximately the same rate of decrease as in Michigan, notwithstanding the fact that the number of nets used in Ontario increased, during this period, 32 3-5% as against an increase of only 9 1-5% in Michigan. In this connection, it should also be remembered that Michigan has never afforded anything like adequate protection to the small whitefish, while the more rigorous Canadian laws have given very efficient protection to these small fish. When I consider the large quantities of small immature whitefish that have been taken with pound nets during the last twenty years, I often wonder that there are any whitefish left in the waters. In the Michigan waters under consideration, I find that 1,588 pound nets were in use in 1895; no restrictions being placed on the number of nets in a string, or the number of strings in a locality. During the same year in the same waters in Ontario, there were only 342 pound nets in use, and they were restricted as I have indicated above.

Tons of small whitefish are caught yearly from Michigan waters with pound nets; and a large part of them are sold for herring and listed in the Michigan fish statistics as herring. To bear me out on these points, I quote from the report of Mr. C. H. Moore, statistical agent of the Michigan Fish Commission, who furnishes numerous letters from fishermen and other data to substantiate his statements. Mr. Moore says: "Of the 1,717,-220 pounds of whitefish caught in this district (No. 5) in 1895, 470,000 pounds (27%) were immature fish and every ground in this district fished with pound nets furnished a portion of this amount of small whitefish in greater or less quantities, but more notably so at Marquette and Detour, where liberal plants of whitefish have been made during the past five years. In this district as well as in the others, the use of the pound net is the chief device in the destruction of the young whitefish."

"At all the above stations small whitefish are taken, and the fishermen in reporting their annual catches, put them under the guise of herring.

"The catch of immature fish and the wasteful manner of fishing practiced by the fishermen throughout Michigan's entire coast, especially where pound nets are fished, is a matter of great concern, and is doing more than any one thing to deplete the Great Lakes of whitefish and must ultimately ruin the fisheries of the State." In contradistinction to this state of affairs in Michigan waters, I find but one or two instances in the reports of the fishery overseers of the Canadian fisheries where mention is made of immature whitefish being taken in Ontario waters, in which, as I have shown, only a limited number of pound nets are used.

If the young whitefish caught in Michigan waters and listed in Michigan statistics as herring were properly listed in those statistics, Michigan's apparent annual catch of whitefish would be considerably increased.

It is evident, then, that the whitefish caught in Canadian waters are, by virtue of good laws, well enforced, larger and average a greater weight per fish than those caught in Michigan waters; and it follows that for the same number of pounds of whitefish in the aggregate, Michigan waters produce many more whitefish than are produced in the same waters in Ontario. It should be noted here, too, that Michigan's annual catch of whitefish from the waters under consideration is larger in the aggregate of pounds than the catch from Ontario waters, although Michigan has less coast line on those waters than Ontario.

Thus, on the whole, we get a showing very favorable to Michigan waters with fishing the year round as against Ontario with a close season of twenty-five years' standing. I firmly believe that this favorable showing for the Michigan waters is due to the fact that the Canadian Government has not planted as many whitefish fry in the waters which we have been considering as the Michigan Fish Commission has planted.

What has been said of depleting our waters of whitefish by catching the young immature fish, is also true of lake trout, though the manner of taking the small lake trout is different. During the last few years the fishermen have found it profitable to reduce the size of the mesh of the gill nets used in catching chubs, blue-fin, and herring. With these small meshed nets, they are catching large quantities of small, undersized lake trout. This should not be permitted to continue if we are to keep the lake trout in our waters and on the market as a commercial fish for future generations.

The conditions existing in Michigan waters in relation to a close season, the planting of whitefish fry, and the taking of small whitefish and lake trout, as herein set forth, apply with equal force to Wisconsin waters.

Last year I had the pleasure of taking a trip up Lake Winnipeg and looking over the fishing industry, picking up what information I could relative to fish and fishing on that lake.

Taking into consideration the laws in force relative to catching whitefish, to an onlooker, it would seem that the whitefish could never be exterminated from Lake Winnipeg. No pound nets are permitted in the lake, and no gill nets of less than five and one-half inches mesh. Fishing with nets is not allowed within ten miles of the mouth of any river. All nets are taken out of the water on Saturday and are not reset until the following Monday. No small fish are caught. The whitefish caught will average four pounds each. The government permits but a certain number of fathoms of nets in the lake at one time, and these must be set on certain grounds.

With these restrictions on fishing, it would seem that this lake should be productive of whitefish for all time to come. However, such does not appear to be the case. In talking with the foreman of one of the fish companies at Selkirk, I asked him if whitefish are as numerous now as when he first went there, which was some twelve years ago. He replied: "When I first came up here, we would go out in the lake with a tug, and I would hold up my fingers to the Indians to indicate the number of fish that I wanted. Every finger that I held up would mean one hundred fish, and they were off with their canoes and dip-nets and would get us all the fish we could carry on the tug.

To-day, our tugs go up on the fishing grounds, some two or three hundred miles, to get their supply of fish."

The decrease in the number of fish caught in certain parts of the lake became so perceptible that in 1890 the government appointed a commission to go to Lake Winnipeg and investigate, to find the cause, if possible. At this time the use of nets having five-inch mesh was permitted, but the fishermen preferred to use nets of five and one-half inches mesh. It cannot, therefore, be said that they were catching large quantities of small whitefish with small meshed nets. This decline in the catch of whitefish was and is taking place under a close season which has been in force several years.

Boys who began chasing whitefish on Lake Ontario, then on Lake Erie, Huron, Michigan and Superior, you will find to-day as aged, white-haired men, still chasing whitefish on Lake Winnipeg.

If the government does not soon begin to plant large numbers of whitefish fry in this lake, in another decade the whitefish of Lake Winnipeg will be a thing of the past, in spite of the close season and the stringent laws which they enforce for their protection.

I consider the close season for fishing on the Great Lakes as being in the interest of the syndicate of fish dealers, who, while the fishing is closed for thirty days, are given an opportunity to dispose of their frozen fish which they have stored in their freezers in the northwest, to the disadvantage of the small fishermen on the lakes.

I believe that if it were not for the liberal planting of whitefish fry in the Great Lakes, the whitefish would have been practically exterminated years since. What we need is protection for the small fish; and artificial propagation will keep the lakes and streams well supplied with desirable food fish.

Secretary Whitaker: So as to correct the record, I desire to say that Mr. Nevin has made an error in his figures, so far as Michigan is concerned, as to the decrease or dropping off of whitefish. In 1885 the statistics were taken by a man who was very thorough in what he did, but he didn't begin to cover the territory that has since been covered by the man now in charge; the figures of 1885 didn't show the total catch of that year. The catch of whitefish in 1885, as shown, was something over 8,000,000 pounds; the last report shows something like 3,000,000 and some pounds. It has been going down rapidly. Mr. Nevin has made a mistake in his figures.

Prof. Birge: Your year would be 1885; Mr. Nevin's report is as to 1893.

Mr. Whitaker: Of course all the value there is in statistics is to show the exact facts. If you will take 1885 and other years that we have reports of clear down to 1895, you will see that the figures show a decrease of whitefish each year reported down to 1895, when it was 3,353,187 pounds, showing a very much larger per cent. of decrease than would be indicated by your figures. You don't take your figures far enough down to show the effect of it. I fancy Michigan has been the largest planter of whitefish in this country, yet we find an enormous decrease in the catch. It is necessary that something be done to arrest this. Statistics are valuable so far as they go, but you cannot draw from the facts what Mr. Nevin seeks to show, that the loss or decrease is not so great in Michigan as in Canada waters and that planting under present conditions has sustained the catch in our waters.

Mr. Spencley: Wouldn't the same conditions exist in 1885?

Mr. Whitaker: Yes, but what I say is, that the statistics did not cover the waters as completely in 1885 as they have since 1891. I believe in hatching whitefish; Michigan has done as much as she could, and she has had the assistance of the United States in that work, yet notwithstanding the immense numbers of whitefish planted, the falling off in catch has been enormous.

Mr. Clark: I have a short paper and after hearing Mr. Nevin's paper, I want to say that my paper treats upon this same subject; that is, in a general way. Before any general discussion is had, I think it would save time to present it, and perhaps others. Wouldn't it be better to present the papers pertaining to this subject and then take up the discussion? I would like to present my paper now and then have the discussions.

Prof. Birge: I move that the papers that deal with the subject of fish propagation be taken up now.

President May: I want to announce the committee on the nomination of officers. The committee will be Mr. Gunckel, of Ohio; Mr. Dale, of Pennsylvania; Mr. Whitaker, of Michigan; Mr. Spencley, of Wisconsin, and Mr. Clark, of the United States Fish Commission.

Mr. Dale, chairman of the Executive Committee, presented the following names for membership and reported a recommendation that they be accepted, and moved the adoption of the report.

The names presented are as follows: D. Lydell, Mill Creek, Mich.; H. H. Marks, Paris, Mich.; J. P. Marks, Paris, Mich.; A. C. Babbitt, Sault Ste. Marie, Mich.; J. W. Powers, Paris, Mich.; H. B. Stranahan, Cleveland, O.; F. F. Stranahan, Cleveland, O.; F. A. Stranahan, Cleveland, O.; E. M. Ball, Put-in-Bay, O.

The motion carried and the candidates were elected.

Mr. Clark then read a paper on "Notes in Connection with the United States Fish Hatcheries in Michigan," which follows:

NOTES IN CONNECTION WITH THE UNITED STATES FISH HATCHERIES IN MICHIGAN.

At the twenty-sixth annual meeting of this society a paper was presented by Mr. Titcomb, of Vermont, on "Wild Brook Trout Spawn." In connection with that paper there was a discussion with reference to the facts presented in all their aspects, and mention was made by me in this discussion of our work of collecting wild brook trout spawn on the Au Sable river in Michigan, a stream formerly known as one of the greatest grayling streams of the United States, but now stocked with brook and rainbow trout. Thinking that perhaps some notes in connection with this work might be of interest to the members of the society, I will lay them before you.

First, however, let me answer the question asked last year by Mr. Bryant, of Wisconsin, as to the difference between fry from eggs taken from wild trout and the fry from the eggs of domesticated trout, whether there was any difference in their vitality, growth, etc. In this connection I would say that 5,000 fry from the wild trout eggs for the season of 1898, after being fed three months on liver and obtaining the length of 2½ to 3 inches, were placed in a spring at the Northville hatchery, where they were subjected to the same environments that they would be in a natural stream or pond; or in other words, they have received from that time up to the present writing no artificial food and they were placed in the spring the fore part of June. From all observations, which have been made practically daily, these trout are doing remarkably well and not a single dead fry has been found. It is, of course, possible that some of them may have died and become fouled in the moss and weeds of the spring, but from the showing at the present time, there is probably the larger percentage of them alive and healthy.

These trout have now been in the spring about forty-five days and are assuming a different color from those that are being fed on liver; the tails and fins are becoming highly colored. I think this also partly settles one of the mooted questions in reference to planting partially-reared fish, that fish raised on liver from six to eight months and then planted, would starve to death before they would accustom themselves to their changed environment and to finding their own natural food. So much in answer to the question that I was unable to answer a year ago. Now to our work of collecting wild brook trout for spawning purposes, on the Au Sable river. This was undertaken by the United States Fish Commission in the fall of 1895; men were dispatched to this river late in August and a camp was formed on a branch that had been previously leased by the United States Fish Commission for the purpose of building ponds for temporary use for holding trout. I quote from the report to the United States Fish Commission in reference to these ponds:

"A dam was thrown across the stream and 100 feet above a screen was built to prevent the fish from escaping in that direction. This dam was simply constructed, being built of mud, sand and turf banked up, and had a frame sluiceway 3 feet long, 2 feet wide and 2 feet deep, with the necessary double screen put in the overflow to prevent the passage of fish below, making an inclosure about 100 feet long by an average width of 12 to 15 feet. This inclosure accommodates about 10,000 fish."

The fishing was commenced with rod and line soon after the camp was established, and occasionally with the seine, to collect fish in that manner. The rod fishing was continued until about the 1st of October, when the trout commenced running on the beds, and then the seine was used exclusively.

The first season there were taken from the stream by rod and line and also by the seine, upwards of 6,000 trout; from these in the neighborhood of 400,000 eggs were taken; the first eggs being taken about the 1st of October. These were placed in troughs that had been previously arranged.

As soon as ripe fish are found among those caught on the spawning beds, the pond is hauled with a seine and the fish are looked over twice a week until all the eggs are taken. When the season is fairly opened the spawn may be taken from most of the fish immediately after they are caught, thus obviating the difficulty of transferring them from the point of capture to the pond; in some cases a distance of three or four miles. I quote from my former report in describing the troughs used:

"The water is received through two one-inch orifices in a bulkhead about nine feet long, situated at the head of these troughs and fed by a roughly-constructed raceway leading from a small spring about six rods distant on the hillside. The water from each of the openings feeds two troughs so placed that the lower end of the upper one rests upon the head of the other, thus creating a fall of nearly the height of the troughs. Each trough is 14 feet long, 5 inches deep, and consists of a double row of boxes; each box 17 inches long, 15 inches broad and 2 inches deep, giving a capacity of from 8,000 to 10,000 eggs."

As this was an experimental year for this work, the experiments made were noted, and one very important and essential matter in connection with this work was that conclusions in regard to the experiments were very positively determined.

The eggs, after being eyed, were transferred to the Northville Station. On one of the trips in transferring eggs an experiment was made in connection with moving eggs at different ages; from those freshly taken, to the twenty-second day. From these experiments it was definitely concluded and positively proved that in moving brook-trout eggs at this stage they should be moved not later than the eighth day, inasmuch as those moved between the eighth and eighteenth days were practically a total loss.

From these experiments we came to the conclusion that all eggs taken on the Au Sable River at least, should be moved as soon after taking as possible or held until the eyes plainly show.

In the season of 1897, thinking that fully as many eggs would be obtained without using the rod and line, our men were not placed on the Au Sable until the latter part of September, and the work was begun with the seine about the 25th of that month. From that time until the middle of November there were upwards of 10,000 fish taken, probably all of them with the seine. The eggs were dispatched to Northville within a few days after they were taken from the fish, and in some instances the day they were taken, and in no case were they allowed to be older than eight days.

Our success in obtaining a good percentage of wild brook-trout eggs was not as marked as that reported by Mr Titcomb at the meeting last year; we were not able to obtain over 70 per cent. of good eggs; possibly had they been carried forward to the eyed stage on the Au Sable River they would have done somewhat better. In my opinion, it is not possible to remove wild brook-trout eggs from the Au Sable River and have as high a hatching percentage as is secured from domesticated fish in ponds. At least, that has been our experience on this river. And yet, the Au Sable River is probably one of the best-adapted streams for a work of this kind in the United States; the only drawback, if any, is the small size of the fish.

From the experience and observation of all practical fish-culturists, it has been concluded that not more than 5 per cent. of brook-trout eggs are hatched in a state of nature. Our observations on the Au Sable River have verified this. It is impossible for a large percentage of eggs to be impregnated in the rapid water of that stream. Impregnation is not only more difficult for this reason, but the rapid action of the water, in addition to that of the fish, often covers many of the eggs with gravel to such an extent that they are smothered; while large quantities of those not thus destroyed are subsequently eaten by the fish. In our work we took from 400,000 to 500,000 eggs. If these had been left in their natural element not more than 25,000, or at most 40,000, would have hatched, whereas by artificial impregnation and culture, at least 70 per cent. were preserved, resulting in from 280,000 to 350,000 fry. Of these, 100,000 were planted back in the Au Sable River and its branches this season. From this it will be seen that it is not only practicable and of great advantage to take the eggs from the wild fish, hatch and plant them again, but that the very stream from which they were taken this season is better stocked, to the extent of about 60,000 or 70,000 fry than it would have been if the eggs had not been removed, and this does not take into consideration the several hundred thousands that have been planted elsewhere. Nature, both in forest and stream, notwithstanding her prodigality, is sufficient for self-maintenance, and under favorable circumstances for gradual development, but as is well known, is not sufficient both for self-maintenance and the supply of man's wants. A stream once stocked and left entirely undisturbed, will not decrease in its number of fish, but will invariably do so if there is an unusual draft upon its resources, either during the entire year or during any number of months of each year. For this reason a partially-closed season is seldom, if ever, sufficient to preserve the desired equilibrium. For this method to be absolutely effectual, the closed season should extend over eleven months of each year, if not the entire twelve. But in my opinion it is not absolutely necessary to close the season during any part of the year; it is only necessary to save and mature the incalculable resources that nature now wastes, and thereby by human assistance enable nature to accomplish that which would otherwise require centuries. If it is ever practicable to take the eggs from the wild fish, impregnate, hatch, and plant them back, open seasons will then be as necessary for the removal of the fish as closed seasons are now supposed to be for their preservation. Indeed, it might even then be possible to remove all restrictions as to the sale of fish. Then, that which is now the sport of the few would become the occupation of many, and the fish that is now a delicacy would be found in any market and on every table.

But even if the artificial hatching of the eggs of wild fish is not yet practicable, it is probable that the closed season is not only not beneficial but in some cases detrimental even under present circumstances. With some classes of fish, it is better, far better, to leave the season entirely open, restrict the taking of fish at all times to those that are mature, and during the spawning months require the deliverance of all ripe fish to the hands of Government and State employes for the preservation of their spawn and the return of the same either as eggs or fry, back to the stream or lake from which they came. This would remove the fish now in the way of growing stock, preserve the food necessary to the young fry, and prevent the destruction of large quantities of eggs now consumed by the matured fish.

But whichever of these plans may be adopted in the near future it is evident that the results of substituting artificial for natural methods is a paying investment, and that we have not only passed beyond the fear that nature's resources may be exhaunted, but we now know that we can multiply them at will and to any extent that humanity may need, provided the means are at hand to obtain the spawn from the fish.

With reference now more particularly to the Au Sable, I have no hesitancy in giving it as my opinion that for an egg-collecting station it is far ahead of any other stream that has come to my notice. The United States Commission or the Michigan Commission should undertake the problem of establishing one of the largest egg-collecting stations in the United States on this river. Ponds and long raceways should be constructed for holding large numbers of parent fish; these may be held from year to year, and no serious obstacle would arise to prevent so doing, in addition to taking wild fish from year to year.

One of the great drawbacks to most fish-cultural establishments has been a limited quantity of water, the station nearly always outgrowing the water supply. This would never be the case were a station established on the Au Sable, as the quantity of water is practically unlimited. It is safe to say 1,000,000 parent fish may there be carried in ponds and raceways if desired.

With a large establishment located on the Au Sable, from 10,000,000 to 20,000,000 eggs may be collected, carried forward to the "eye" stage, then shipped to other fish-cultural stations. This matter has been laid before the Commission, and it is hoped the work may be undertaken, if not by the United States, I should recommend the matter to the Michigan Commission.

Mr. Bower then read a paper by F. B. Dickenson as follows:

THE PROTECTION OF FISH AND A CLOSED SEASON.

From boyhood's days I have been deeply interested in the subject of fish and fishing, but until quite recently, almost wholly from the standpoint of an angler. As an angler, I was seldom brought into contact with fish life during the season of natural reproduction, for I was led to believe that all fish should be let severely alone at breeding time. Quite naturally, therefore, I had little or no opportunity to observe nature's ways and methods of reproduction, nor to compare the results thus obtained with results under the shielding hand and fostering care of man.

But time's changes led me to accept the office of Commissioner of Fisheries for the State of Michigan; a State that not only has within its borders innumerable lakes and streams of unrivalled character, but is itself bordered by more miles of fresh water than any other state or country on earth, except Canada. I soon realized that I had accepted a position of no little responsibility, for, in addition to the thousands of square miles of inland waters that needed attention, important commercial interests must be controlled and conserved by wise legislation.

For a number of years the question of prohibiting fishing on the great lakes during the month of November had been agitated in our legislative halls, the object of which was to allow all of the whitefish and lake trout to spawn naturally. Without investigating for myself, and accepting it as a matter of course that such a measure of prohibition would be wise, I worked earnestly and zealously for the enactment of the present closed season law.

During the controversy that finally resulted in the passage of this law, many points were developed that set me to thinking and investigating, and I have continued to think and to investigate until I am thoroughly convinced that, under the conditions that prevail, this law was a most unwise and untimely measure.

I soon discovered that men with heavy vested interests whose value depended on a continuance of fishing for a long term of years, and who had experienced the benefits derived from artificial propagation, were in favor of open fishing in November, with its accompanying concomitant, artificial propogation. Through much correspondence and by personal interview, I soon learned that experienced fish-breeders and fish-culturists everywhere were a unit in agreeing that the law was a blow at the only possible means by which the fisheries may be indefinitely sustained. I have not found a single practical fish culturist who favors the law.

Fish must be caught during the spawning season to protect their spawn, and as such protection to the spawn makes more than a "Hundred blades of grass to grow where one grew before," such profitable increase should not be handicapped nor put under the ban, but should be encouraged and taken advantage of to the fullest possible limit. With open fishing during the spawning season and means provided for saving the spawn, to be multiplied in hatching results many hundred fold, we were on the right track to restore and maintain our fisheries.

But the introduction of young fish by the millions should be followed up with other measures. Undoubtedly a large percentage of the young fish from hatcheries are destroyed by natural enemies, as are the young hatched from natural spawning grounds. This of course cannot be helped; but for man to step in and become an ally of nature in the destruction of partially grown fish, is an offense that cannot be too severely condemned and penalized.

So far as reproductive results are concerned, where provision is made to save the ova, it matters not whether spawning fish are caught by commercial fishermen, or whether boards of fish commissioners turn themselves into commercial fishermen by hiring the same men and apparatus, employing the same methods and disposing of the fish at the highest market price.

But there are one or two points in connection with the catching of spawning whitefish and lake trout by commercial fishermen, that should be incorporated into law throughout the Great Lakes. For the most part the fishermen are more than willing to save the spawn for hatching, although the work of stripping the fish and caring for the ova involves some labor and expense. Still, commissioners should be empowered to require that the crew of every boat or vessel fishing on spawning grounds, should include at least one expert spawn taker, and a heavy penalty should be laid on a failure to save and fertilize the spawn and turn it over to hatchery agents without expense to the State. If new spawning grounds are discovered, they should be reported at once. In case the spawning fish are caught at inaccessible points, where it is not practical to deliver the ova to hatchery agents, it should be fertilized and returned at once to the spawning shoals. I don't think very much of this plan, however, as unquestionably most of the ova thus deposited is destroyed, but the hatching percentage would be somewhat better than in nature, for nearly perfect fertilization would be obtained. Under the circumstances it would be the best that could be done, certainly much better than to allow it to waste absolutely.

There is another point that would be good law for the Great Lakes and perhaps for other waters. While the catching and marketing of commercial fish should for the most part be left to private enterprise, still the control of this form of public property, the title to which in a wild or natural condition, is vested in the States, should not necessarily be relinquished, and the title extinguished or considered as having been passed at the point of private possession. The public should be empowered to say, through its authorized agents, when the title to public property should pass. This law would enable us to control, for the purpose of holding the breeders a few days in suitable enclosures, whereever practical to do so, to allow the ova to ripen and become available for hatching; then, when stripped of the spawn, turn the adults over to those who caught them.

During the past year I have had considerable correspondence with experienced fish-culturists and investigators, on the subject of a closed spawning season and protective legislation. Recently I addressed several of the old employes of our Commission, asking them to submit a free, candid and unbiased opinion as to the merits or otherwise of a closed spawning season for the whitefish and lake trout of the Great Lakes, and I hereby sumbit their letters in reply:

(From Charles H. Moore, Statistical Agent, Michigan Fish Commission.)

Hon. F. B. Dickerson,
State Fish Commissioner,
Detroit, Mich.

Dear Sir:—It is very gratifying to me that the question of artificial propogation and a closed season are being taken up and the benefit derived from the former to our commercial fisheries, placed where it belongs.

The experience and opinions of men who have fished the waters of our Great Lakes for the past forty years should be of some value, especially so from a practical standpoint. By following this industry year after year, they learn the habits of the various kinds of fish taken from these waters, and know upon what grounds to go to catch them. They become experts in the business. They can tell you where the spawning grounds of the lake trout are and the season of the year the parent fish visit them, also their feeding grounds at other seasons of the year. Of the whitefish they will tell you that they go about the lakes upon their wonted feeding grounds and spawning beds in schools; hence are more easily trailed and more susceptible of capture than are the lake trout.

Those of intelligence and long experience say, too, that the schools of whitefish make about the same tours through the waters each year; therefore they conclude that they are not migratory to any great extent. This theory they sustain in saying that it is a fact that the whitefish are more abundant in portions of the lake where the fry have been more generously distributed.

In the minds of the more intelligent fishermen there is no longer any doubt about the good results of planting. When compared with natural propagation, they will tell you of three very destructive causes that surround the conditions of ova cast in open waters. First, loss by lack of impregnation, which carried on in open water must be very great; second, loss from the horde of spawn eaters that are always found upon the grounds during the spawning season; third, loss from the elements, which means a great deal to the whitefish, as they go upon clean shoal ground to spawn during the rough, stormy season of November. The hatcheries eliminate entirely the last two causes, and practically so the first; therefore the conclusion arrived at is, make the annual output of our hatcheries as large as possible, if the improvement and perpetuation of our fisheries are desired.

The good effect of this work is shown in the improved take of whitefish in '96 and '97 from the Straits of Mackinaw to the Beaver Islands, covering that portion of Lake Michigan where plants of the young fish have been made with more regularity each year than elsewhere. The catch of whitefish upon these grounds for the past three years is as follows :

	No. 1.	No. 2.	No. 3.	Total.
1895	57,250	13,410	40,740	111,400
1896	205,726	31,405	46,753	283,884
1897	366,180	40,820	92,620	499,620

While the increase above shown is essentially true, another feature of the catch is also disclosed, namely: more than one-third of this yearly increased take were immature whitefish, 2's, 3's and under, and has a hundred fold greater effect in their destruction than taking the adult fish from their spawning beds. Could the wasteful catch of the small whitefish be arrested and planting pushed to its fullest extent, I fully believe that the perpetuation and increase of the whitefish in our Great Lakes can be carried to a successful end. On the contrary, if planting is withheld and we rely wholly upon a closed season for their preservation, the schools of whitefish in the waters of our Great Lakes will very soon nearly disappear.

(From H. H. Marks, Overseer of State Fish Car, Michigan Fish Commission.)

Hon. F. B. Dickerson,
Michigan Fish Commission,
Detroit, Mich.

Dear Sir:—In reply to your request for my opinion of the results obtained from planting whitefish, and of a closed season during the spawning time, I will say that the conditions as they are now are all in favor of an open season and artificial propagation.

I base my opinion upon observations for the past ten years, as my position with this Commission as Field Foreman, collecting whitefish and lake trout eggs, has given me the very best opportunity to see the results of planting whitefish by this Commission, and the results obtained by a closed season in Canadian waters. The condition of the fisheries on the Canadian shore of Lake Superior, from Sault Ste. Marie, Ontario, to Pilot Harbor, are a closed season from November 1st to December 1st, a law regulating the size of mesh of both gill and pound nets, a limit to the number of yards of gill nets fished by each tug and sail boat, also a limit upon the number of pound nets fished to a mile of coast, and all of these laws are rigidly enforced. The results to-day are that the fish are diminishing in size and number. These grounds are controlled and fished by one firm, who find it necessary to let the grounds rest after being fished two or three seasons. The results from the closed season and other restrictions are not sufficient to keep the fisheries up so they can be fished profitably.

On the American shore of Lake Superior, for the same distance of coast line, from the Sault to Grand Marais, where the closed season law has never been in force until last year, or the amount of nets limited to tugs or sail boats, nor the number of pound nets limited to the amount of coast line, the grounds are fished by two of the largest firms in the business, besides numerous small ones. These grounds have received large plants of whitefish fry from the Sault Hatchery in the past seven years, and the result is that for three years there has been a large increase in the catch of whitefish on these grounds. Last year I was informed by the fishermen at Whitefish Point that during June and July their catch was larger than it had been for ten years, and there was no doubt that it was from the result of planting, as the fish were different from their usual run of whitefish in Lake Superior. This is easily accounted for and proves conclusively that the whitefish taken from these grounds were planted fish, for the majority of fish planted on these grounds were hatched from eggs taken on the Detroit River, and it is very easy to distinguish a Lake Erie whitefish from those of Lake Superior.

From the results obtained on Lake Superior, where one shore has had a closed season and a number of other restrictions, and the other having the benefit of artificial propagation, but no protection, I have come to the conclusion that the only salvation for the commercial fisheries is the protection of the small fish until they have come to maturity and by artificial propagation. I think I can safely make the statement that Lake Superior has always had a closed season for whitefish, for I know of but a few grounds where whitefish have been taken in November, that were spawning fish. I believe that a majority of the whitefish spawn in the latter part of November and the first part of December, when it is almost an utter impossibility to fish for them.

The argument used by a great many in favor of a closed season is that the fish are not disturbed while spawning. This is true, but as there is only a very small per cent. of the whitefish eggs fertilized naturally, besides having numerous enemies, the chances of ever hatching or coming to maturity are very small. By disturbing the spawning function, however, and running the eggs through a hatchery, 60 to 90 per cent. of the eggs taken are returned to the waters as fry. All of the fish that come to the spawning ground are not taken; many spawn naturally, and as each female produces upwards of 25,000 eggs, if a very small per cent. of the spawn naturally cast would hatch and come to maturity, it would be more than double the amount caught every year.

If the brook trout in the streams protected by a closed season of eight months and until they have come to maturity, will not produce enough fry naturally to keep the streams stocked, how can any one believe or expect a closed season of whitefish and lake trout to keep the Great Lakes stocked?

(From Dwight Lydell, Overseer Fish Hatchery, Mill Creek, Mich.)

Hon. F. B. Dickerson,
Fish Commissioner,
Detroit, Mich.

Dear Sir:—In response to your request for my ideas of our closed season law, I hereby submit what I think of the same.

If we are going to have a closed season for whitefish and lake trout, why not admit at once that the artificial propagation of these fish is a failure, which we know to be false. And if a closed season, for these fish will keep up the supply, why surely it would do the same for every other species of fish that we propagate. The brook trout that are only caught with a hook and line and have a closed season eight months of the year, would soon become nearly extinct in most of our streams, if it were not for the planting of the fry nearly every year. Now, with this fact before us, how can we ever expect a closed season to keep up the supply in our Great Lakes?

A closed season for one month does not cover the spawning season anyway, as the fish in different localities do not spawn at the same time. For example, take the wall-eyed pike of Saginaw Bay and the same of the St. Clair River. In Saginaw Bay they spawn in April, but the St. Clair fish spawn in May. This I know to be true, as I used to finish spawn-taking operations at Saginaw Bay the last of April and go from there to the St. Clair River and commence operations about the 3rd of May, finishing about the 26th of May. This shows why some of our fishermen favor the closed season. You pass a law to prohibit the fishermen at Saginaw Bay from fishing in April and you would hear a howl from that part of the State, but the St. Clair fishermen would pat you on the back and say that law was all right, and just what the State needs. Why? Because their fish would then be the first in the market and would command a good price. Now, just reverse the law and have it for May and you would have all of the Saginaw fishermen climbing over one another to shake your hand. The same thing exists with all species of fish from all over our State. So it is impossible to please or hurt all by a closed season for one month. But when a man, a fisherman I mean, approves of a closed season, you just investigate and you will find that the law does not affect him in his locality, but puts money into his pocket.

The only species of fish that a closed season would help is the black bass, because they fertilize nearly all their eggs, and if not disturbed while on their beds, they will hatch nearly all the eggs and then protect their young until they are able to care for themselves.

If a closed season for the bass, which fertilizes nearly every egg, will not keep up our supply, what can we expect from other species that probably don't fertilize one egg in a hundred, and spawn promiscuously over a considerable area of ground, then pass on and leave the eggs to their fate, to be destroyed by all kinds of enemies? Why did not we the spring we dredged in the Detroit River right over the spawning grounds every day for two weeks, get some good whitefish eggs? We got some poor ones. This work was done long before the time for hatching. If there were any good ones there to start with, they must have died from some cause or other.

I think I could take one pair of whitefish and artificially propagate their eggs and plant the fry in one lake, and you could take five hundred pairs with a closed season in the spawning season in another lake of the same size, and take out 200 adults each year from each lake, and I would have whitefish in my lake when you had forgotten how fish smell.

Then what is the sense of having a closed season for whitefish and lake trout, when every fishing ground in Michigan of any importance is covered with spawn-takers, at the spawning season? Sixty to ninety per cent. of the eggs taken by the Commissioners are fertilized and hatched and returned to the waters in a good, healthy state; when, if left to spawn naturally, they would fertilize only a small per cent, saying nothing about the chances that small per cent. takes of ever hatching.

I think the sooner a fish is taken from the water after it matures the better it is for the young generation, provided you take the adults at the time when you can return a young generation from them; for what food it takes to provide for one adult one day would sustain a number of small ones for a week. And as for catching the whitefish or any other fish, excepting those that make a spawning nest and guard it, like the bass, I say the time to take them is when they are spawning, provided you have spawn-takers on the ground. But even if you haven't the spawn-takers on the ground, the loss to the lake would not be as great as it would if the same fish were taken a week before spawning time, for if taken in the spawning season, some of the eggs have been deposited, but if taken before then they are all lost.

I think our small shore fishermen have it hard enough without closing the season and stopping him from fishing the only time in the year he has a chance to make a cent. You practically drive him out of business and give what he makes to the large firms that have large fishing rigs and tugs to follow the fish back to deep water. And any man after having a few years' experience amongst our fishermen and out on our lakes, and understanding the extraordinary gain in hatching results by passing the spawn through a fish hatchery, can come to but one conclusion, and that is that the time of all times when fishing for whitefish and lake trout should not be prohibited, is the spawning time.

I have always found that all fishermen in their honest hearts believe in the artificial propagation of fish, but there is sometimes a limit to a man's endurance. After being hampered for about so long, they will fight, and when a man fights any old weapon will do if he can only come out on top. Some of the arguments used by the fishermen, although they don't believe them themselves, will take every time with a man that does not thoroughly understand fish culture and the spawning habit of fish in nature. Rather than be hampered every two years they would sacrifice the Fish Commission, but if handled rightly they would be the best friends the Fish Commission ever had.

(From J. W. Powers, Overseer Staté Fish Hatchery, Paris, Mich.)

Mr. F. B. Dickerson,
Detroit, Mich.

Dear Sir:—The question of a closed season for commercial fishing in our Great Lakes having been referred to me for an opinion I beg leave to submit the following:

It is claimed by those who favor a closed season that the fish will increase in numbers and size under this method of protection. Having been engaged in the artificial propagation of fish for the past twelve years, I am forced to hold an opposite opinion. If you are allowed to take the adult fish during the spawning season, obtain the ova, put it in your hatching house, hatch out from

60 to 85 per cent, then put the fry back on the spawning bed in good condition, can nature compete with this? Most emphatically not.

Now, take the other side of the question: We will let the fish alone to spawn naturally. We all know that the whitefish do not make their beds on the bottom, the same as do many of our inland lake fish. They rise rapidly in the water, letting go their eggs at the same time. The male fish is supposed to rise the same time the female does and fertilize the eggs. In my opinion not 10 per cent. of the eggs come in contact with the milt, or, in other words, get fertilized.

Now these eggs sink to the bottom where they remain 120 to 175 days before any hatch. During this time they are exposed to all their enemies, which are too numerous to mention, to say nothing about the constant moving and shifting and washing from the reefs to sand or mud bottom, to be buried up and lost.

Taking into consideration both methods of propagation, which is most likely to increase our supply of commercial fish? I say most surely artificial propagation and the open season.

Suppose the closed season is going to be the means of restoring the supply of commercial fish in our Great Lakes, why not apply the same remedy to all the waters in the country? We have a closed season on brook, rainbow and brown trout and grayling eight months of each year. Is this sufficient to keep up the supply? No. If it were not for the hundreds of thousands that the Commission hatch and plant in the streams every year, in a few years there would be no need of a closed season, or an open season, for there wouldn't be enough fish left to bother with. And it is my opinion that the closed season for whitefish and lake trout, without the help of artificial planting, will result the same as with brook trout.

(From A. C. Babbitt, Overseer State Fish Hatchery, Sault Ste. Marie, Mich.)

Mr. F. B. Dickerson,
Fish Commissioner,
Detroit, Mich.

Dear Sir:—In response to a request for "fish lines," I enclose a collection that has been accumulating for some time

It is quite interesting to pry into nature's methods and note her supreme efforts at reproduction in nearly all forms of submarine fauna; surpassing anything of the kind on the terrestial sphere. If the magnitude of the effort be surprising, its results, or lack of results, is rather startling.

To illustrate, it will only be necessary to mention a few well-known varieties, beginning with the brook trout, whose habitat is perhaps most isolated—that is, fontinalis has fewer coinhabitants of his domain than do other species inhabiting larger bodies of water, and in consequence fewer obstacles to reproduction are present.

In harmony with its environment, the parent fish is required to make but a moderate effort at procreation, spawning an average of about 800 eggs yearly as a guaranty of the perpetuation of her kind; while the lake trout, whose neighbors are legion, deposits an average of 10,000 ova, showing that the namaycush contends with greater odds. Again, whitefish, of the same genus, living under somewhat similar conditions as the lake trout, are far more prolific in ova, contributing an average of 28,000 eggs annually in her procreative efforts, demonstrating that the species is surrounded, or subject, to still more unfavorable conditions. The sturgeon, representing another genus, deposits about 200,000 ova, while the ling stakes 800,000 eggs that she will inure a posterity.

Notwithstanding this prolificness of ova in these varieties, the net increase is phenominally small, the decimal .002 with brook trout and .000002 in case of the ling would probably more than cover the actual net yearly increae, under strictly normal conditions. It would be impossible to enumerate the different agents of destruction causing such enormous waste; the principal reason, however, is well known to students of nature. Nearly or quite all varieties of fishes are spawn eaters, that is, ova deposited by one species is eagerly sought and devoured by another, the spawning ground of a class becoming in turn feeding grounds for representatives of a different species.

Obviously, depletion of a certain species without a corresponding reduction in numbers of its coinhabitants, would seriously retard nature's recuperative efforts in behalf of the partially exterminated class, as "balance" would be destroyed and unnatural conditions prevail.

As instances of rapid depopulation of virgin waters may be cited two of Michigan's most magnificent streams, the Au Sable and Manistee Rivers. Through a long residence near the head waters of both these streams, whose sources may be compassed in a three-mile walk, I became familiar with their early history.

In 1872 their banks were in a primitive state, their waters teaming with grayling. The character of the Manistee River, with its clean, sandy bed and colorless water, together with the peculiarly local and home-loving instincts of grayling, made it a favorite fishing ground, affording at the same time unrivaled opportunities for the student of fish nature. Possessed of gregarious habits, hundreds of grayling might have been counted in pools of fifty yards in extent. After five seasons' fishing with hook and line, the hundreds of former times were represented by dozens.

During the five years of depletion, natural reproduction had gone on uninterruptedly, the spawning period being covered by a closed season, and logging operations not yet begun—here was the chance of a lifetime to observe nature's powers of rehabilitation. Results have proven conclusively that her best intentions comprehend but little more than restoration of natural waste, that equilibrium may be maintained. Aboriginal man seems to have been provided for in her pristine plan, his simple needs being simply a factor in the maintenance of balance; that civilized man, however, was an unreckoned force there is no room for reasonable doubt.

The Au Sable River of to-day is an unparallel instance of succession of species. In the space of twenty-five years its original stock of grayling—the accumulation of ages—has been practically exterminated and the establishment of brook trout accomplished, to the extent that old-time repleteness has been attained. Rehabilitation has been accomplished, artificially, in thirteen years, dating from 1885, opposed by the same destructive forces that were responsible for the swift depletion of the original species. If man in various ways was responsible for the destruction of a species, he has also been an active agent in the establishment of its successor, to what extent may be left to inference.

Experiences of twenty years devoted to practical fish culture leads me to deduce the following: That, even though fishing operations on the Great Lakes were suspended absolutely, restoration of partially exterminated species to their original numbers, through natural reproduction, would occupy ages. Moral: let nature furnish eggs in the rough; let fishermen provide means for the preservation of immature fish. Hatchery products can do the rest.

A comparison of natural with artificial propagation of fishes, as to results, may shed a ray of light on the efficacy or otherwise of a closed spawning season for whitefish and lake trout; the enforcement of which must necessarily curtail the output of hatcheries.

If natural reproduction be so slight under the most favorable conditions—such favoring state being simply a natural environment—how much less must be procreative results after balance has been destroyed, in the depletion of a species without corresponding reduction in numbers of its coinhabitants; certainly chances against natural reproduction of a class thus depleted would be multiplied—in fact, it will cease to be natural simply for the reason that the run-down species is handicapped by existence of unnatural conditions. Such conditions now prevail.

It is conceded, I think, that the greatest natural waste occurs during the period of incubation; beginning immediately after extrusion of the ova. During this period more than 99 per cent. of whitefish ova is wasted, through destructive agencies, or lack of fecundation. Thus, the procreative efforts of two adult whitefish would probably be represented by less than 100 fry. Now, it seems equally probable that less than 1 per cent. of these fry reach maturity. If it were otherwise, over-production would ensue—that is, if in a pristine state of nature, procreative efforts of fishes duplicate or double their adult numbers yearly, their habitat would quickly become over-populated—in other words, the waters would not hold them. The sequence is obvious—it means that a pair of adult fishes, working under strictly natural conditions, will add less than an average of one representative of their kind yearly, which lives to reach maturity.

Let us now get at approximate results of artificial propagation of whitefish. It is a well-known fact that an average of at least 70 per cent of artificially handled ova from this species hatches. Allowing a loss of 10 per cent. of the fry in transportation and from other causes, leaves 60 per cent. of the entire number of eggs produced by an adult whitefish, to be returned to the waters in the form of vigorous fry. In brief, a pair of mature whitefish taken from their spawning bed, compensate by a return of 16,000 active fry, as a result of artifice.

Now we will consider the chances for and against the maturing of hatchery products. Incubation proceeded, in hatcheries, in water of a natural temperature; the period being neither shorter nor longer than under natural conditions. In transition from hatchery to habitat, the same conditions obtain. Scientific research develops the ubiquity of organic forms, on which the fry of whitefish subsist. Carefully conducted experiments also prove that hatchery products quickly detect such matter, profiting to the extent that substantial growth is quickly apparent. Thus, in the battle for existence, the products of our hatcheries are placed on practically an even footing with naturally hatched fry. To be conservative, however, we will allow that but one in 500 of the vigorous, artificially produced fry, reaches an adult age. This extreme concession will give the handsome net result of 32 full grown whitefish to compensate the removal of two parent fishes from their spawning bed, and subjected to piscicultural art.

If properly supported—in the preservation of immature fishes —there is no question as to the adequacy of artificial propagation in the restoration and future maintenance of the fisheries of the Great Lakes. Such support has been denied; resulting in a steady decline in the productiveness of our fishes. That a remedy for this should be inaugurated is imperative. Of the efficacy of a closed spawning season as such remedy and as a means of restoration and the preservation of immature specimens, it is practically nil. Nature's methods of replenishment produce infinitesimal results, which are of no consequence when opposed to the enormous drain of commercial fishermen.

Young fishes, guided by instinct developed in them by successive stages of growth, do not see spawning grounds while yet immature, but instead, infest food producing ranges, where midsummer fishing with murderous, small-meshed pound nets, is responsible for the destruction of untold thousands of this class; from this cause comes the blight upon propagatory efforts. That fishermen have thus so persistently wrought their own undoing seems incredible.

Instances may be cited where a closed period for the spawning function seems to have produced the good results claimed for it. We will take, for example, the pronounced success of artificial propagation of brook trout. Every one knows that wonders have been accomplished in this direction, but to what success has been due to closed spawning months is, perhaps, not so well known. I cannot but believe that to other existing conditions should be attributed the accomplishment of a major portion of the good effects in brook trout culture. That a closed time affects the saving of adult fish, for the time being, there is no room for doubt; but the infinitesimal results of natural propagation add very little its efficiency as a means of restoration or support. On the other hand, suppose conditions were such as obtain on the Great Lakes, that is, let the enforcement of six-inch limit regulations be discontinued, permitting indiscriminate slaughter, regardless of size. Let the open season extend from March 1st to September 1st. Remove the embargo against the sale of brook trout by interstate laws. Add to this an urgent market and a fair price for brook trout. Contemplate results!

I will say in closing this paper that I give the foregoing letters from men of practical experience for what they are worth. My investigations, I must admit, have educated me in favor of an open season, but I would demand certain restrictions. With no restrictions, and no hatcheries, a closed season is better than nothing. If representatives of the Commission were allowed to go on the boats of the fishermen and take the spawn, without expense to the State; or, in case no representatives of the Commission were present, the fishermen were required by law to strip the mature females and impregnate their spawn and ship it to the hatchery, or when not practical to do so, place it back in the water; and the size of whitefish, lake trout and pike perch be limited to practically mature size; and it be made an offense against the State for fish under these sizes to be found in one's possession, I believe, from the investigations that I have made, that our waters would not be depleted as rapidly as under our present closed season law. On the contrary, I believe a perceptible increase in the fish supply would soon be manifest.

I would also suggest that it be made the duty of Fish Commissions to instruct commercial fishermen in the art of stripping and impregnating the spawn, and that it be the duty of all fishermen to always have in their employ a man who has learned the practical method of stripping, impregnating and handling the eggs. This done, it occurs to me that all fishermen would take a personal and selfish interest in saving every egg possible for the hatcheries.

When fish commissions and fishermen pull hand in hand for the restoration and preservation of our fish supply success will crown their efforts. Let them get together then on some common ground that will be of the greatest good to the greatest number.

Mr. Seymour Bower then read the following paper:

NATURAL VERSUS ASSISTED REPRODUCTION OF CERTAIN KINDS OF FISHES.

If all the members of this society were practical fish-culturists, I should need to apologize for introducing much that is trite and stale to the experienced fish breeder. But a good many of the members, perhaps a majority, have had little or no opportunity of observing nature's plan of reproducing certain forms of water life; hence, to be understood by all, it has seemed necessary to include much that is obvious to the more experienced.

Ages ago, before the advent of man on mother earth, the reproduction of all forms of animal and vegetable life appears to have been so adjusted to environing conditions that the net increase or decrease of any given form or species was imperceptibly slow. Indeed, since natural laws have not changed, we may well believe that centuries, if not ages, must have elapsed before natural evolution insured an abnormal predominance or led to extinction. The universal law then, as it is to-day in strictly wild or natural areas, was that natural increase barely balanced natural losses, so that the various species for the most part merely held their own.

The entrance of primitive man upon the scene, however, was the injection of a mighty factor into the economy of nature's forces, for man was to be a friend and ally of many existing forms, and an enemy of others. Considered merely as an animal, man's advent projected another and a keen competitor into an arena where the struggle for subsistence and existence was already fierce.

But man's mission, although destructive in some ways, was also creative, for his part in the scheme of creation was to conquer and subdue, and outdo nature by harmonizing and pacifying her warring forces. Being endowed with at least the germs of intelligence, he discovered, in course of time, as his numbers increased, that he must of necessity create if he would survive to multiply and replenish the earth; for otherwise, with man as a merely destructive agent, the earth would eventually be divested of all forms of animal and vegetable life available for his subsistence. In course of time, it dawned upon man that God merely pushes the button and man must do the rest—or starve. The Creator furnished the raw material and formulated the inexorable laws governing it; and while man is powerless to create or annihilate a single atom, he is yet endowed with the cunning to so lead and direct the elements and forces of nature, and to so interpret her reproductive methods, as to multiply results many fold.

And thus down through the ages has man waxed mighty in numbers and power; demonstrating and increasing, from time to time, as he grew in intelligence, his superiority over unaided nature's productive power, through discoveries of latent forces and hidden resources, and by ringing new changes and playing new combinations on the various forms of matter.

As unaided nature is barely self-sustaining, she is utterly inadequate to cope with both natural and artificial losses; artificial inroads must be recouped through artificial agencies or depletion, if not extinction, is inevitable. Thus, if the hand of man were to-day withheld, and the primitive, closed-season principle of strictly wild or natural reproduction were applied to all forms of animal and vegetable life, the earth would soon be a desert waste, stripped and depopulated.

It is quite natural, for obvious reasons, that nearly all of the discoveries since man appeared that have contributed to his triumphs over nature in the production of animal and vegetable life, should be confined to land flora and fauna. In the very nature of things we cannot hope to control conditions on water as on land, nor to coax nature's secrets from ocean's depths, or even from more restricted water areas, as easily as on land. Investigation has developed the fact, however, that the same unceasing warfare is waged in the waters as on wild or primitive land areas, and that there is the same inability with the varied forms of life to more than hold their own. As on land, we find that the forces of nature merely balance, that natural gains are checked by natural losses; and that the moment man invades this domain and becomes a factor in the losses without directly or indirectly contributing to the gains, that moment depletion begins.

It was evidently a part of the Divine scheme, however, that the waters should not be depleted, but should remain a fixed and unfailing support for man; for, as with life on land, the means were placed within man's reach whereby he might repay the waters, could make complete restitution, through artificial agencies for all artificial losses. It seems strange that the way for man to thus square himself with the waters, a discovery of such far-reaching importance and significance, should have been overlooked until recent years; for when the Creator provided that many of the forms of water life, in order to survive in nature's environment, must develop thousands upon thousands of germs for each recurring period of reproduction—and each germ a possibility for an adult of its kind—He not only proclaimed the self-evident fact that tremendous odds were to be encountered, but purposely left an opening that was a standing invitation to man to investigate and see if these possibilities could not be converted into probabilities or actualities. And this conversion, by protecting the germs during the germ period, constitutes what is known as artificial propagation—an artificial gain that repays both artificial and natural losses.

And what, it might be asked, has all this to do with laws that prohibit fishing during the spawning season? Of course, this question will not be asked by those who can read words of two and three letters in a fish-cultural primer, for the deductions are obvious, and the application of the general principles laid down, clear and unmistakable.

But right here I wish to digress for a moment and register a vigorous protest, make an emphatic kick, against the further use of the term "artificial propagation," as applied to this method of producing fish. While technically correct, its use is undoubtedly responsible for most of the unwarranted prejudice that exists against this plan of reproduction. To the uninformed the word "artificial" is associated with something wholly at variance with the natural; it suggests the idea that the fish produced in this way are an unnatural substitute, something inferior to, or different from the strictly wild or uncultivated product.

As a matter of fact, there is no more artificiality in the so-called artificial propagation of fish than in a thousand and one other forms of human activity or intervention, or in all forms of production in which the hand and brain of man are a factor in influencing or shaping results. For example, we might, with equal propriety, refer to the ordinary method of raising wheat as the "artificial propagation of wheat" and it would be technically correct to do so.

In the popular mind, fish-culture has too long been discredited and regarded with suspicion through the pernicious influence of this world. We should drop it, throw it off as an incubus, an old man of the sea, that the popular mind may be undeceived and freed from error and prejudice. I earnestly urge all fish-culturists to blacklist it, to strike it from their fish-cultural vocabulary. For myself, I have issued a declaration of independence, turned over a new leaf, sworn off. From now on *protected* propogation is the motto inscribed on my fish-cultural banner.

And now let us return to our fish-cultural kindergarten for a while and try to learn that two and two make four.

In order to propagate fish by protecting their ova, the adults must be caught by fishing in public or private waters during their spawning season. If exposure of the ova in nature's wilds is productive of greater hatching results than to take the ova and protect it from nature's enemies, or if there is no alternative for natural spawning by reason of circumstances forbidding the saving of the ova, then it is wise to stop fishing during the spawning period. If, on the other hand, catching the spawning fish and protecting their ova during the ova stage results in hatching several hundred young fish where only one would hatch without such protection, then it must be clear that the wisest course is to catch the greatest possible number of spawning breeders; that, instead of preventing their capture by law, the greatest freedom and encouragement should be given, in order that this wonderful life-saving process may be employed to the greatest possible extent.

Where open fishing is allowed during the spawning season, and it is practical to save the ova and develop it to the hatching point in hatcheries—as in the case with the trout and whitefish of the Great Lakes—to deliberately close this season against fishing is to assume that the percentage of ova hatched in nature's wilds is something near the result obtained by intercepting the deposit of the ova and shielding it from all forms of natural dangers. Indeed, advocates of a closed spawning season, to be consistent, must regard the wild as superior to protected incubation, for is not the one deliberately chosen to the exclusion of the other? And is not non-interference with natural spawning their slogan, and the avowed object for which the season is closed?

As closed season laws are enacted for the express purpose of allowing natural spawning, let us consider some of the environing conditions into which the ova in nature are thrown.

The hatching point constitutes the dividing line between two important stages or periods of fish life. During the second stage, that of the fish proper, it is literally true that the big fish eat the little ones and eternal vigilance is the price of existence. Still, almost from their entrance into this period they are able to move about with greater or less facility, and thus to some extent elude their pursuers by seeking a cover or refuge; and later on they may develop offensive or defensive powers.

Not so, however, with fish life in the first or ovum stage. Possessed of no powers of locomotion, the germs lie inert and helpless, at the mercy of all the enemies of ova life. Whatever dangers environ must be encountered without powers of resistence, or means of defense or escape. When lying on the reefs and shoals, no human power can intervene to stay the destruction—the terrible gauntlet must be run.

The parent whitefish and lake trout, in common with a large group of fishes, do not protect their spawning beds. They select cleaner and more suitable grounds than some other species, but their concern for the welfare of the germs that they deposit with such lavish prodigality ceases when that function is performed.

Then, the wolves of the waters, lurking and prowling, and with whetted appetite, immediately assemble for the feast that a closed season law sanctions and applauds. The spawning grounds become in turn a feeding range; for without exception the spawning grounds of all kinds of fish that do not guard them, become merely a pasture for others. And why not? The ova of all fish are rich, oily, nutritious, a toothsome dainty for even the pampered palate of man. I imagine that the wolves and buzzards and lizards of the waters are even yet winking the other eye, and making merry, and throwing bouquets at themselves, because the solons of two great States were hoodwinked into exploiting the closed season law as a measure of "protection" to whitefish and lake trout.

Nor is the exposure for a period of 125 to 175 days to the tender mercies of spawn-eating animals the only dangers which whitefish and lake trout ova must encounter in nature. The blasting blight of fungus, penetrating and permeating inert masses of unmanipulated ova is of itself sufficient to destroy all germs not completely isolated in the cavities and crevices of rocks and stones. The ova is visited with still other forms of destruction, but these need not be mentioned.

Beyond question, an overwhelming percentage of the loss in the life history of most fishes that do not guard their spawning beds, occurs during the ovum stage. All things considered, it would be a miracle if one in a hundred survived to the hatching point, and odds of five hundred to one would be quickly taken by the most conservative investigator.

The whitefish casts about 30,000 eggs each spawning period; provides, under perfect conditions, for 30,000 young fish; but in nature's domain, under the counterfeit "protection" afforded by the closed season law, these 30,000 eggs probably hatch less than 100 fish. And yet, such meagre results would doubtless suffice for merely natural losses, a posterity would be insured, and the species would hold its own; but to expect, in addition, that such feeble recuperative powers will honor man's drafts indefinitely without bankruptcy, is to expect to find a Klondike at either end of a rainbow.

Compare the results of this delusive and fallacious scheme of protection with the bona fide protection afforded through open fishing and protected environment for the ova. By this plan a single spawning of the whitefish, 30,000 ova, will produce 15,000 to 27,000 young fish, varying according to circumstances. Allowing that but one in three of the breeders not spawned out when caught is in spawning condition, and still the closed season natural spawning plan of producing whitefish is overwhelmingly outclassed.

But, instead of eagerly seizing the only brief opportunity that is allowed to thus create where nature destroys and save where nature wastes, the law says no, we will blindly turn from this golden opportunity whereby we may not only recoup for the fish removed during this period, but also for those taken at other times, when recompense is impossible.

Masquerading and deceiving, through the seductive influence of the word "protection," the closed season law commits the unpardonable folly of denying the opportunity to intervene and rescue and vitalize millions on millions of germs otherwise doomed to certain destruction. To thus protect by destroying is to add by subtracting and multiply by dividing.

Although the hatching percentage of brook trout in nature is undoubtedly much higher than that of the lake trout and whitefish, yet no better illustration of the pitiful inadequacy of natural propagation need be cited than the trout streams of Michigan. Hundreds of non-indigenous streams were quickly stocked through the agency of protected propagation. Fishing has been limited to hook and line for a season of four months, alternating with a period of eight months' rest. Clearly this was a most favorable opportunity for unaided nature to prove her ability to stand up against nature's losses and the inroads of man; in short, for the closed season propaganda to vindicate itself. Surely a closed spawning season should be more than able to stand the strain of four months' angling if it is expected that the same remedy will sustain the wholesale methods of commercial fishing. But we find that in the more accessible streams the stock soon dwindles, fishing grows poorer, and periodical contributions from the hatcheries, to reinforce nature's feeble efforts, are necessary.

If the natural spawning for which closed season advocates so plausibly contend be the unfailing panacea for toning up and sustaining our commercial fisheries, consistency demands that we close our brook trout hatcheries and rely on the same remedy for the streams, where the conditions are much more favorable for nature to sustain herself. If a new stream or system of streams is to be stocked, transplant a few adults and let nature, with a closed spawning season, do the rest.

No doubt much confusion arises in the lay mind because practical fish-culturists favor an open spawning season for lake trout and whitefish and a closed one for brook trout. If the latter were like the former in their habits and movements at spawning time, open fishing would be the wisest possible plan that could be adopted, for then millions of ova that are now wasted could be saved and hatched, and there would be no necessity of going to the expense and trouble of holding a stock of adults under control the year round for the sole purpose of procuring a supply of ova. But with nature's stock of brook trout, there is no practical way to save the ova, if open fishing were permitted, and hence for wild brook trout there is no alternative for natural spawning. At spawning time the breeders disperse to innumerable brooks, where, if fishing were allowed, they would fall into an indefinite number of hands that could not if they would, save the ova and hatch it.

But lake trout and whitefish, like a good many other species, instead of scattering, concentrate their forces at spawning time. The reproductive instinct assembles the parent stock into schools on a comparatively few well-defined and well-known shoals, thus making it practical to cover all fishing points with experts prepared to save the ripe ova. The expense of holding a breeding stock in constant confinement, as conditions compel us to with brook trout, is rendered wholly unnecessary

It may be noticed, in passing, that when a stock of brook trout are held for breeding purposes, thus giving us an option on propagating them by either natural or protected methods, every possible precaution is taken to prevent the former. According to the closed season creed, we commit the unpardonable sin of "interfering with" and "disturbing" the sacred function of natural spawning. If we followed the creed and allowed the breeders to bed and spawn in the ponds and raceways, the meagre hatch would, if carefully reared, recruit the ranks of the adults, but there wouldn't be any surplus for distribution. By violating the creed, however, and running the ova through a hatchery, the gain in hatching results enables us to distribute a million fish annually from a stock of two or three thousand breeders, and still retain enough to keep up the parent stock. But when we come to whitefish and lake trout the closed season law enforces adherence to the creed plan of merely breaking even, and refuses an option on a plan that is absolutely certain to yield immense gains.

To illustrate the common sense, practical plan of "cropping" certain waters, like similar areas of land, let us note the conditions of whitefish life in Crystal Lake, a beautiful sheet lying in Benzie County, near the shores of Lake Michigan. This lake is one of the very few inland waters of Michigan that contain whitefish, or that are capable of supporting the species in considerable numbers. Judging from the number that assemble on its stony shoals during the spawning month of November, the lake probably contains a stock of twenty to forty tons of adult whitefish. As fishing is limited by law to methods that are ineffective so far as whitefish are concerned, these fish serve no useful purpose, except as their ova and young contribute to the food supply of other and less valuable denizens.

But so far as the production of whitefish is concerned, this fertile area, capable of yielding an annual crop equal to the present matured stock, might as well be so much desert. It is obvious that if all of the adults were removed in any one year the sources of food that sustained them would support a like number the following year, and so on indefinitely. To reap this crop year after year, however, fishing by effective means must be allowed, and a due proportion must be taken from their spawning grounds, so that sufficient ova may be touched by the magic wand of protected propagation to provide for future crops. Each crop must be reaped as fast as matured, else there is no room for a succeeding one. But without protected propagation we would soon reach the last link in the chain; with it we would have the link that unites the ends into an endless circuit.

And what is true of Crystal Lake is true of the Great Lakes and many other waters. The trouble with production in the Great Lakes is that far too many whitefish and trout are slaughtered in immaturity, and too few adults are permitted to reach their spawning grounds to allow the saving grace of protected propagation to be employed on a scale of sufficient magnitude. It seems a great pity that the parent fish when approaching their spawning grounds, heavily laden with ova nearly matured but still worthless for reproductive purposes, should be intercepted. A few days of closed season at this particular time would be the kind of protection that protects. By postponing their capture for a few days, until the spawning grounds were reached, the wanton waste of an untold number of germs might be prevented and, through the magic touch of man, be called into life.

The saving of adults that is claimed for the closed spawning season is more apparent than real, for a season closed at any time, whether by law or the weather, merely postpones their capture. There is no real gain or increase of adults—their numbers are not added to. Thus, the adults that are shielded in November are for the most part caught before the following November. They are protected from capture for the time being, but in so doing we lose the enormous difference in hatching results between natural and protected methods.

A reckless disregard of the principles herein set forth has brought some of the Great Lake fisheries to a point where it may become necessary, for a time, to reap our annual crop of whitefish and lake trout as the farmer does his grain, namely, when the seed is ripe. Thus, if we would open our present closed season and close our present open season, the production of the young, through the agency of protected propagation, would be so greatly increased that but few seasons of this kind of sowing and reaping would be required to increase the annual crop to the highest productive limit. Until this limit was reached the more we would thus reap, the more we could sow, and the more we would thus sow, the more we should reap. With fish as with grain, it is just as essential to reap at the right time in order to be able to sow as to sow at the right time in order to reap.

In the vegetable world we endeavor to destroy or exterminate what is obnoxious by attacking it while it is yet green, but what we would save for reproduction we protect until it is ripe. Thus, the farmer cuts his grain when ripe and his weeds and thistles when green. During most of the year our commercial fish are treated as weeds and thistles, killed off without limit while their seed is green. And then, when the seed is ripe, instead of treating them as grain, the closed season law caps the climax of economic blindness and folly by saying, hands off, these fields of waving gold, nodding and beckoning for the sickle, must remain untouched; the seed must return to mother earth undefiled, the contaminating touch of the hand of man must not supervene, for then the sacred function of reproduction would not be strictly natural!

Under the circumstances, so drastic a measure as closing the entire open season would not of course be wise, nor is it necessary. But to hold on to the present closed season is to "go forward backwards" with accelerated speed. Under the conditions that obtain throughout the Great Lakes, a closed spawning season for whitefish and lake trout is simply suicidal. By a false pretense, like a wolf in sheep's clothing, a closed spawning season for many kinds of fish does not protect but destroys them.

If we haven't enough hatcheries to shelter all the ripe ova available, the remedy is not to force the hatcheries already established to close by preventing the capture of spawning fish, but to provide additional capacity, so that all the ova that it is possible to reach may be transferred from a scene of tumult and anarchy, may be rescued from the riot and chaos of nature's savagery and brought under the beneficent and fostering care of man.

Mr. Whitaker: Before it is overlooked, I think the matter had better be taken up that was laid over, to designate some one to represent this society in response to the letter of Mr. Cacheaux. I present the name of Prof. Birge to represent this society in that capacity.

Mr. Clark: I will say that I am going to try to go to the Paris Exposition.

Mr. Whitaker: I suggest in addition to Prof. Birge, the name of Mr. F. N. Clark to act on that committee.

Mr. Bower: I would suggest also the name of Mr. Whitaker.

Mr. Stranahan: I move that three be appointed—Prof. Birge, Mr. Clark, and Mr. Whitaker—to attend and represent this society on the committee referred to in the communication.

The motion was seconded and carried.

Mr. Whitaker then read a paper by Mr. Livingston Stone, Superintendent of the United States Fish Commission Station, Cape Vincent, N. Y., on "The Origin of the American Fisheries Society," which follows:

THE ORIGIN OF THE AMERICAN FISHERIES SOCIETY.

On the first day of November, 1870, the following call was sent to various persons who were known to be interested in the culture of trout:

"The undersigned, desirous of promoting the interests of fish culture, call a convention of pisciculturists, at the Skating Rink, City of New York, December 20, 1870, at 11 o'clock a. m.

"The design of the convention is consultation for the protection of our interests, and, if thought best, to organize a permanent association.

"(Signed) "W. CLIFT,
"A. S. COLLINS,
"J. H. SLACK,
"F. MATHER,
"L. STONE.

"Mystic Bridge, Ct., November 1, 1870."

This was the very first step taken towards the forming of the American Fish Culturists' Association, now known as the American Fisheries Society.

The prime mover in the issuing of this call was Rev. Mr. W. M. Clift, of Connecticut, who was carrying on, at that time, a large fish and stock farm at Mystic Bridge. It is undoubtedly true that the chief motive for issuing the call was, as the call plainly states, a desire to do something for the protection of the interests of fish culturists. It is also true that from the very first moment of the assembling of the meeting, as will be seen later on, the mere pecuniary interests of fish culturists became a secondary consideration. It should be stated here, by way of explanation, that the term "fish culturist," at that time, meant trout breeder, for there were then no practical fish culturists in this country except the trout breeders, and it may also be added that trout breeding meant the raising of the brook trout, or speckled trout, of New England and New York, now, I think, generally known all over the world by its Latin cognomen, fontinalis.

The call was accordingly addressed particularly to those engaged in the raising of trout.

It is true that the State of New Hampshire had created a Fish Commission six years before, and the example had been followed by several other States. The Fish Commission of Massachusetts had already contributed to the world, through its reports, some of the most valuable information ever published on the subject of fish culture. Seth Green had already done successful work in hatching shad, the writer had built and operated a large salmon hatchery in New Brunswick, various States had experimented successfully on narrow lines in propagating other fish than trout, but the extensive and varied work of the United States Fish Commission, created a year later, had not been begun, and hatching work in this country on all other fish than brook trout (S. fontinalis) had, up to that time, been experimental rather than practical, so that fish culture not only meant trout culture, but trout culture meant the breeding of the fontinalis, or brook trout.

It was to brook trout breeders, therefore, that the abovementioned call was issued, and the object of the call was to form an association for the protection of their commercial interests. But upon the assembling of the meeting, it became apparent at once that something altogether broader and less personal was in the minds of those present, and I think I can truly say that that which I may perhaps term the selfish feature of the call scarcely ever showed itself at all in the meeting. From the very beginning of the meeting, the little group of men assembled, appeared to be actuated more by an earnest and generous interest in the cause of fish culture than by a desire to promote private ends. The spirit that prevailed seems to me to have been that which has characterized the meetings of the Association ever since. It was comprehensive rather than narrow, devoted rather than self-seeking, and good-will to all prevailed over sordid feelings of competition with each other. If I remember rightly, hardly a word was said about regulating the prices of fish culturists' products or increasing the pecuniary profits of the business. Not a resolution bearing upon the pecuniary side of the subject was passed. It seems as if this handful of pioneers had a foresight of greater and better things. At all events, if the pecuniary considerations had anything to do with prompting the call of the meeting, they had no place in the meeting itself. The meeting having come to order, and a temporary Chairman and Secretary having been chosen, it was voted at once and unanimously to form a permanent organization, and Dr. Edmunds and the writer were appointed a Committee to draft a Constitution. Each member of the Committee presented a separate form for a Constitution, the one offered by the writer being the one finally adopted.

As the records of the early meetings of the Society have been lost, it may not be out of place to present here the original Constitution, as it was adopted at the time of the organization of the Society.

It is as follows:

CONSTITUTION.

ARTICLE I.—Name and Objects.

The name of this Society shall be "The American Fish Culturists' Association." Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success; the interchange of friendly feeling and intercourse among the members of the Association; the uniting and encouraging of the individual interests of fish culturists.

ARTICLE II.—Members.

All fish culturists shall, upon a two-thirds vote of the Society and a payment of three dollars, be considered members of the Association, after signing the Constitution.

The Commissioners of the various States shall be honorary members of the Association, ex-officio.

ARTICLE III.—Officers.

The officers of the Association shall be a President, a Secretary and a Treasurer, and shall be elected annually by a majority vote.

Vacancies occurring during the year may be filled by the President.

ARTICLE IV.—Meetings.

The regular meetings of the Association shall be held once a year, the time and place being decided upon at the previous meeting.

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.

(Finis.)

It is rather interesting to note how few changes have been introduced into the original Constitution during the twenty-eight years of the Society's existence.

It is also sad to note how few of those who took part in the organization of the Association have lived to see its growth. There is no one now living, I think, except Dr. Edmunds, then Fish Commissioner of Vermont, and the writer, who were present at this first meeting, or who took an active part in the organization of the Society.

A report of the meeting of organization that appeared in the New York Citizen, which, by the way, was the paper of Hon.

Robt. B. Roosevelt, who afterwards became such an ardent and influential supporter of the Association, read as follows:

"The Constitution having been adopted, the following officers were chosen for the ensuing year: W. Clift, Mystic Bridge, Ct., President; Livingston Stone, Charlestown, N. H., Secretary; B. F. Bowles, Springfield, Mass., Treasurer.

"It was then moved that an effort be made to secure an exhibition of live fish at the next meeting, and that the following gentlemen be requested to prepare papers, to be read at the next meeting, on the subjects annexed to their names:

"A. S. Collins—On 'Spawning Races and the Impregnation of Eggs.'

"J. H. Slack—On 'The Culture of Black Bass.'

"W. Clift—On 'The Culture of Shad.'

"Dr. Edmunds—On 'The Introduction of Salmon into American Rivers.'

"B. F. Bowles—On 'Land-Locked Salmon.'

"Dr. Huntington—On 'Fish in the North Woods of New York.'

"Livingston Stone—On 'The Culture of Trout.'

"It was decided to hold the next meeting and exhibition in connection with the New York Poultry Show, next year. It was voted to send a report of the meeting for publication to the New York Citizen and Round Table, the New York Tribune, the Springfield Republican, the New York Poultry Bulletin, and other papers at discretion; and the Secretary was instructed to mail the published reports to fish culturists generally."

Following is an account of the first annual meeting of the Association, taken from a New York paper of February 8, 1872:

"At the afternoon session yesterday the following officers were elected for the ensuing year: President, Wm. Clift; Treasurer, B. F. Bowles; Secretary, Livingston Stone; Executive Committee, Seth Green, J. D. Bridgman and A. C. Rupe.

"A paper was read by A. S. Collins on spawning races and impregnation of eggs; a paper by W. Clift on the culture of shad, and a paper by Dr. Edmunds on the introduction of salmon into American rivers.

"A box of a hundred trout eggs that Mr. Stone had taken by the Russian or dry method were examined, and 97 per cent. were found to be impregnated. The interest of the meeting was very much increased by remarks interspersed during the intervals by Seth Green.

"At the evening session B. F. Bowles read a paper on 'Trout in the North Woods,' and L. Stone read a paper on 'Trout Culture.' Discussion ensued on the dry method of impregnation, and the expression of those who had used the method was in its favor. G. S. Page moved that a memorial be presented to Congress for a more general distribution of ova throughout the country, and the motion was carried.

"Interesting remarks were made by Hon. Horatio Seymour on fish culture. . . . . He suggested that an effort be made to learn more in regard to fish culture in China and Japan, and also to obtain desirable varieties of the fish of those countries and introduce them into the United States. In pursuance of the suggestions, Messrs. G. S. Page and the President, Mr. Clift, were appointed a committee to communicate with various foreign countries and take measures for an interchange of fish with those countries.

"Gov. Seymour and Livingston Stone were appointed a committee to take charge of the publication of the proceedings of the Association.

"To-day's proceedings.—The Association met at 10 o'clock this morning (February 8, 1872), President Clift in the chair. Some routine business was transacted, when the following resolutions were offered:

"1. To petition the Government to establish two or more fish hatching establishments—on Puget's Sound and the Atlantic Coast.

"2. To seek foreign exchanges.

"3. For a permanent fish exhibition in Central Park.

"4. That the headquarters of the Association be at No. 10 Warren street, New York, where the next meeting, in February, 1873, will be held.

"5. Recommendations to all States to encourage fish culture.

"Messrs. Dr. Streeter, of New York; S. Wilmont, of Canada, and S. F. Band, of Washington, were made honorary members.

"After miscellaneous business, the Association adjourned."

Permit me to close this somewhat lengthy paper with some extracts from the report of my own work as Secretary, during the first year of the existence of the Association:

CIRCULATION OF LAST YEAR'S REPORT.

"In order that the meeting of practical fish culturists in New York, December 20, 1870, the first in the way of organization, in this country, might be generally known, a copy of the report of the meeting was sent to all the leading newspapers in New England and New York, and to some farther West and South, and also to nearly 200 practical fish culturists in various parts of the country.

"I am happy to say that the newspapers in almost every instance printed the report in full or noticed it in some way.

"THE AGASSIZ CIRCULARS.

"For some time previous to the meeting on organization I had held a correspondence with Professor Agassiz on topics relating to fish culture, in the course of which the Professor mentioned a labor in which he is now engaged, of preparing an illustrated work of all the salmonidae of this continent, showing the variations of age, sex, locality, and the like; and after the formation of the Association he suggested that the Association should use its influence in furnishing material for this work. . ..

"I consequently take the liberty here to remind you that this is a most valuable work which Professor Agassiz is undertaking, and one which will be unsurpassed by anything of its kind in the world, and I warmly commend it to the attention and interest of the members of the Association.

"Mr. Agassiz cannot finish his work unless the requisite material is furnished him, and the members of this Society and all interested cannot do the distinguished naturalist a greater kindness, nor the cause of fish culture a better service, than by sending him, as opportunity permits, specimens of the various individuals of the salmon family. . .

"THE ST. LAWRENCE RIVER CORRESPONDENCE.

"During the session of the High Joint Commission at Washington last spring, I received a letter from Hon. Stephen H. Ainsworth, asking me, as Secretary of the Association, to request our State Congressional delegation to use their influence with the Commissioners to adopt some measure towards removing the obstructions in the River St. Lawrence, which prevent the salmon from ascending its tributaries. I accordingly wrote to our New Hampshire Senators and Representatives on the subject." Of the correspondence which resulted, I will merely offer here one letter, and this chiefly because the name of the distinguished writer has been recently brought to the country's attention by the death of his son and namesake in the famous charge of the heroic Rough Riders in Cuba:

Department of State,
Washington, April 20, 1871.

Hon. E. A. Hibbard, House of Representatives:

Sir—In answer to your note referring to a communication from Mr. Stone on the subject of salmon fisheries in the tributaries of the St. Lawrence, I have the honor to say that Mr. Stone's letter was one of many interesting communications on the same subject.

As the obstacles to the free access of the salmon to these rivers are matters within the control of local or provincial legislatures of the British colonies, I have brought the subject and laid several of the letters informally before Sir John Macdonald, from whom, I understand, that the obstructions complained of are prohibited by the Canadian laws, and that the authorities are constant in their efforts to prevent them from being placed in the river, and patrol the river for that purpose, but find it very difficult to prevent the violation of the laws on the subject. He has taken the letters, and assures me that no efforts will be wanting to prevent or punish future violations.

Very respectfully yours,
HAMILTON FISH.

"NEW MEMBERS.

"In the course of the year I took occasion to write to most of the practical fish culturists of this country, whose acquaintance I had made by correspondence or otherwise, to the number of about 200, extending to them an invitation to join the Association. These letters met with various replies, some few were not answered at all, but they were, on the whole, well received, and the replies in most cases contained expressions of interest in the prosperity of the Association.

"The notification circular of the present meeting was sent to all professional and amateur fish culturists whose names were in my possession, and to the Fisheries Commissioners of the various States, and was generally noticed in the newspapers and agricultural periodicals.

"In conclusion, I will merely add that in the course of the year I have mailed 500 letters on business of the Association, and nearly 1,000 circulars and papers.

"LIVINGSTON STONE,
"Secretary A. F. C. A.

"Albany, February 7, 1872."

The next annual meeting of the Association was held about a year later, but the Association was no longer in its infancy. It was now on a firm foundation, and has since contined to grow in strength and favor.

Mr. Whitaker: I move you, Mr. President, as a recognition of this distinguished man's work in this connection, that a vote of thanks be given Mr. Stone for his able paper.

The motion was duly seconded and unanimously carried.

Mr. Clark: You will notice in Mr. Stone's paper that the Society was called The American Fish Culturists' Association, and at the proper time I wish to take up that matter of a change of name. I think the present name of this Society is inappropriate, "The American Fisheries Society." That does not show what this Society is. It merely shows that we are fishermen. The name of the Society should be changed back to the "American Fish Culturists' Association." It carries more of the idea of fish culture with it.

Mr. Whitaker: You will remember Mr. Mather referred to this same subject two years ago and said the reason the name was changed was that the scope indicated by the old title was too narrow.

Mr. Clark: Away back ten years ago, when I think Mr. Whitaker was Secretary of the Michigan Fish Commission, this same question came up. I think the name certainly ought to be changed in some way.

Mr. Barrett, of North Dakota, was then introduced to the delegates by President May, who stated that Mr. Barrett would say a few words on the subject of "Fish Culture in North Dakota."

Mr. Barrett said: Mr. President and Gentlemen: Our State Legislature eight years ago created a Department of Irrigation, Forestry and Fish; the duties whereof have devolved upon myself from that time until this. I give my time and attention to forestry, at the same time fish culture received much of my attention.

I will say that we have no State fish hatchery. The fish are obtained from the United States Fish Commission. It is very difficult to obtain fish from that source for the simple reason that the demand throughout the United States for fish is far in excess of the supply the Government has, and yet North Dakota has received a fair amount of fish, for which we feel very thankful.

Some lakes received fish to the amount of 30,000. Last year I distributed a whole carload of fish.

In my annual report I pointed out the various ways to cultivate fish and how fish could be protected, etc., and I also presented various systems for doing it, and one of them is this, and I have advocated it for ten years. It is what I call the Home Fish Culture System; that is, raising fish on the farms, the water coming from our artesian wells, being lifted by means of wind power and other means from the springs on the farms, and from brooks and artesian wells.

I will say we have made pretty fair progress on some points. There are some men who have been raising fish in that way in an artificial manner on their farms for a number of years. Year before last I furnished one man some thousand brook trout for a little stream on his farm, the source of supply coming from a spring which he had dammed up. A good many artificial ponds are made in that way.

I have been experimenting in raising fish in water lifted into tanks by means of wind-mills, and we have made good progress in that direction. What has interested me most is my success in raising fish in artesian water. I have been advocating this system for ten years and whenever I have had an opportunity I have been experimenting. Last winter I devoted some months to experimenting with fish in artesian water, and I am pleased to say that I met with excellent success. I don't say that my success proves that fish can be raised successfully in artesian water; I want to experiment further. Thus far it has been very encouraging. I know in South Dakota a large number of fish are raised in artesian water, the German carp especially. The fish we experimented with are yellow perch and some other fish, and there were no failures. I desire to say, in conclusion, that this idea can be worked out. It may be made practical in different parts of the West. In North Dakota we have 700 flowing artesian wells. If we could have the fish raised on the farms it would be of great advantage to our farmers and a source of some income.

That you may be somewhat impressed with this fact that fish can be raised in artesian water, and good fish, too; fish that are desirable for food, I will show you some of the fish I experimented with last year. (Mr. Barrett here exhibited specimens of preserved fish.)

Mr. Clark: I move that we now take a recess until to-morrow morning at 9 o'clock.

The motion was duly seconded and carried, and a recess was taken until Thursday, July 22d, 1898, at 9 a. m.

THURSDAY MORNING SESSION.

JULY 21, 1898, 9 A. M.

President May: The meeting will please come to order. I think we had better have read the reports of such committees as are ready to report.

Mr. Whitaker: I think that the Committee on Time and Place of Meeting had better report first. The committee has no written report, but submits the following report:

Your Committee on the selection of time and place for the next meeting of this Society, begs leave to submit the following report. We met and considered the various propositions made to the Society for the next place of meeting. We had invitations from Milwaukee, Philadelphia and Niagara Falls. Taking the whole matter into consideration, the central location of the place and the fact that we have already met in the West two years in succession, it seems to us that it is best to go East, to some central point. Your Committee, therefore, respectfully submits Niagara Falls as the place of the next meeting. After consulting with Prof. Birge yesterday and this morning he suggests it would perhaps more nearly meet the convenience of the men of the colleges who are engaged in biological work and the college examinations, if the fourth week in June were selected. I know the field work on the lakes on which the United States Commissioners have entered will begin hereafter, in all probability, on the first of July, and that would tie up some of these men after that time. We, therefore, recommend Niagara Falls as the place of meeting, and the 28th and 29th of June, 1899, as the time.

President May: You have heard the report of the Committee, what is your pleasure?

Mr. Gunckel: I move that the question be divided and a vote be first taken on the location.

Mr. Peabody: I would like to present the claims of Milwaukee and of Wisconsin very strongly. The climate, situation on the lake and the interest in fish culture taken by the people of Wisconsin and all that sort of thing, we think makes Wisconsin and the city of Milwaukee the most desirable point to meet. The city of Milwaukee has extended you a very cordial invitation, as have the State Fish Commissioners.

Mr. Spencley: If it is thought best to have the Society meet at Niagara Falls, I would like to have it recommended that we meet at Milwaukee the succeeding year.

Mr. Whitaker: I believe it is not within the province of this Society to select a meeting place for the year following next year. Of course we all appreciate the fact that Milwaukee would be a delightful place to meet and we would receive entertainment there that we might not receive at Niagara Falls, but the thing that appealed to the Committee was, that we have now met two years in the West and should get nearer the bulk of our membership another year. We don't want them to think that we have taken this Society to the West and propose to keep it here. We should meet further East next year.

Mr. Spencley: While I support Mr. Peabody's remarks as to his recommendation concerning Milwaukee, I am willing that some other place be selected, because I think in 1900 Wisconsin will be in a better position to entertain the Society than they are now. In other words, the new trout hatchery will be in better shape. I therefore will acquiesce in the report of the Committee.

Secretary Whitaker: I move the adoption of the report.

Mr. Clark: I heartily agree with the report of the Committee on the place of meeting. Am I to understand that this question is to be determined now?

President May: Yes.

Mr. Clark: Just the location?

President May: Yes.

Mr. Dale: I have an invitation from the Pennsylvania Fish Commission for the Society to meet in Philadelphia. I yielded to Omaha last year, but I think it would be more advantageous, as Mr. Whitaker said, to go to a more central point than Philadelphia.

President May: It has been moved and seconded that the report of Committee on Time and Place of next meeting of this Society, fixing the place at Niagara Falls, be adopted; are you ready for the question?

The question was put and unanimously carried, and Niagara Falls was selected as the place for the next annual meeting of the Society.

President May: Now as to the other part of the report, as to the date, the Committee have recommended the 28th and 29th of June, 1899.

Mr. Clark: I really hate to rise on this point, because last year I had so much to say about the time of the meeting. Last year it was put off really on account of many of the United States Fish Commission men. I would prefer to have it come at another time, but I suppose perhaps Prof. Birge and the other University men would not find another date convenient.

Prof. Birge: I think the Society ought to vote to accomodate the greatest number. It is obvious, as the colleges do not close until the fourth week of June, that the college men could not attend on a later date, at the same time we have but two present at this meeting, and I don't know that it is worth while to put the Society to an inconvenience on their account. I have enjoyed this meeting and I should expect to attend the Niagara Falls meeting if possible, but at an earlier date it would be entirely impossible.

Mr. Nevin stated that he favored July 12th.

Mr. Whitaker: It is a matter of indifference to me personally, but we ought to fix the time of meeting so that we can get the largest attendance. The suggestion made as to the date, I think, arose out of some conversation I had yesterday with Prof. Birge. We all know that the interest of the meeting a year ago at Detroit, without being invidious, was very largely contributed to by the gentlemen from the Universities, and it is very desirable, if possible, to have them present next year. I had some conversation with Prof. Birge with a view of accommodating ourselves to the convenience of these gentlemen. He told me the third week in June would be examination week, he thought, and from what he said I thought probably the fourth week in June would be as convenient as any; that was the idea on which the Committee made its report.

Mr. Clark: Of course the United States Fish Commissioners don't want to do anything at all that is going to interfere with the work of Prof. Reighard; but that work is to be carried on not only during the summer but is to be continued continuously, probably next year if the appropriations are large enough to permit it. I certainly don't want to say anything further. I think, take it all in all, it would be as well to have it on the 28th of June.

Mr. Stranahan: With reference to this matter of the professors and biological work. Suppose the work was interfered with in July, they would only have to lose a half a day, aside from the time that they devote to the convention. It would be a pleasant trip for them, and there is no doubt they would like a little rest after a couple of weeks' work. I don't believe it will interfere with one of these men that are at Put-in-Bay.

Prof. Birge: That is my feeling. I move that it is the sense of this meeting that the date of the next meeting be fixed for the 12th of July. I offer this as an amendment to the report of the committtee as to the time of meeting.

President May: The question is on the amendment, placing the date July 12th.

The motion was then put by the president, who said: I am in doubt as to whether the motion carried or not. I will ask for a rising vote.

A rising vote was taken, which resulted in four members voting for the amendment and six members voting against the same, and the amendment was lost.

President May: The vote now will be on the date named by the committee, which is the 28th and 29th of June, 1899.

The motion was seconded and carried.

Mr. Gunckel then read the report of the committee on nominations and moved the adoption of the same.

The motion was duly seconded and unanimously carried, and the following gentlemen were named as officers for the next year:

President—George F. Peabody, Wisconsin.
Vice-President—William H. Bowman, New York.
Recording Secretary—Herschel Whitaker, Michigan.
Corresponding Secretary—J. E. Gunckel, Ohio.
Treasurer—L. D. Huntington, New York.

Executive Committee—J. A. Dale, Pennsylvania; E. E. Bryant, Wisconsin; J. J. Stranahan, Ohio; F. N. Clark, Michigan; J. W. Titcomb, Vermont; W. L. May, Nebraska; Dr. J. A. Henshall, Montana.

Secretary: I understand the next paper in order is the paper of Prof. Birge on the Relation between the Areas of Inland Lakes and the Temperature of the Water.

Prof. Birge: Mr. Clark is anxious to hear the paper by Prof. Bumpus, and if there is no objection I will read it first.

Consent was given.

Prof. Birge then read a paper prepared by Dr. H. C. Bumpus, entitled "The Identification of Adult Fish that have been Artificially Hatched," which follows.

THE IDENTIFICATION OF ADULT FISH THAT HAVE BEEN ARTIFICIALLY HATCHED.

Although the planting of artificially hatched fish in the inland waters may, and often does, yield immediate and undoubted increase, the results of fish culture along the coast are often much less definite, and conclusions are too often based upon the mere opinions of observant, but unscientific, fishermen. The recent excessive abundance of cod along the shores of New England, is probably the result of the extensive operations at the Woods Hole Hatchery. The facts that these fish were small when they first appeared, that they have since increased in size, that they have occurred in localities where cod had never before been caught, and that they are reported to be of a different color from the native variety, are interesting, although to the skeptical they are not absolutely convincing. There is need of some scheme whereby the adults of fish hatched artificially may be distinguished from those native to the locality.

To mark the fry is, of course, out of the question; but is it not possible that the fry mark themselves, i. e., is there not a slight difference between the fish of the same species, but of different, even though contiguous, localities? And if there is a slight difference, does it not present itself in a measurable manner? We all know that the bony rays, which support the dorsal fins, are subject to variation, both in respect to their length and their number. In fishes which have a large number of fin-rays, the variation is often considerably greater than those possessed of only a few. This variation is above or below a certain average or mean number, and the amplitude of variation (that is, the amount of normal increase or decrease in the number) is definite for any given locality. During the latter part of March of the present year several hundred flatfish were examined at the station at Woods Hole with the purpose of determining the amount of variation in animals collected at different localities. The diagram marked "Woods Hole" is intended to illustrate the variation in the number of dorsal fin-rays presented by one hundred flatfish collected near the Laboratory. On this diagram each of the red marks represents a fish, and the marks are arranged in rows according to the number of fin-rays. Thus at the left of the diagram it will be noted that one fish had only 62 dorsal fin-rays, seven fishes had 63 fin-rays, twelve fishes had 64 fin-rays, twenty-two (the largest number of individuals) had 65, eighteen had 66, twenty-one had 67, and from there on the number of individuals almost constantly decrease, nine having 68, six having 69, one having but 70, one having 71, and two having 72. A curve, then, drawn through the culminating points of the several columns is a curve that represents, at least roughly, the variation in the number of dorsal fin-rays for this specific locality. The curve indicates that no matter how many flatfish may be collected at Woods Hole, specimens having less than 62 fin-rays will be extremely infrequent, while those having slightly more than 72 fin-rays may occasionally occur. The variation is about an average which lies near the column 66.

If we now tabulate the fin-rays of an equal number of flatfish from another locality, it is evident that if the fishes in both localities are alike, the curves will coincide. If, however, the fishes are different, even slightly so, the lack of coincidence in the curves will indicate the difference.

The diagram marked "Waquoit" is based on the variation in the number of the dorsal fin-rays of one hundred flatfish taken at Waquoit, from a small bay only eight miles east of Woods Hole. Compared with the first curve, the Waquoit curve lies further to the left, has a shorter base and a less altitude. The Waquoit collection contains fifteen fishes which have a less number of fin-rays than any fish collected at Woods Hole, a striking difference when one considers the small number of fish examined. Moreover, the right side of the Waquoit curve is almost equally characteristic, and the average number of fin-rays in the Waquoit fish is very evidently less than the average number at Woods Hole. The Waquoit fish are more variable, the ampliture at Woods Hole being 62 to 72 (11 points), while the ampliture at Waquoit is from 60 to 71 (12 points).

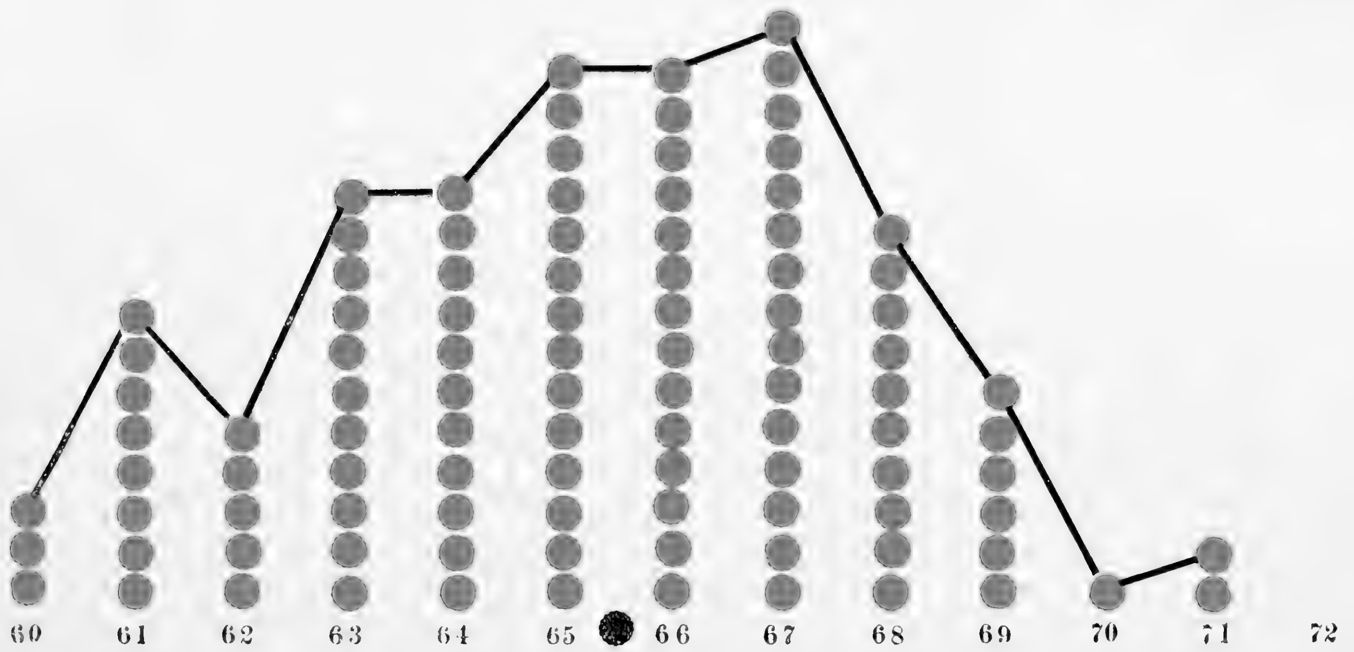
These curves of distribution bring out certain characters that it would be quite impracticable for one to detect by the mere examination of a few representative fish, and it would be quite possible for one to decide by such curves which of two baskets of fish come from Woods Hole and which from Waquoit, even though the fish bore no other mark than that provided by nature.

The practical application of this principle is as follows: If it proposed to test the result of re-stocking a locality in which a species of fish has become reduced in numbers, it is necessary to first determine the "curve of distribution" from fish native to the locality. This curve may be based on any measurable character, such as the number of fin-rays, the number of scale-rows, or the number of vertabrae. When this has been done, it is then necessary to determine the "curve of distribution" for the same structural character of fishes of the same species, but abundantly found in another locality, from which locality the "brood fish" are to be taken. After the "planted fish" have had time to mature, new curves should be plotted for the first locality. If these curves are practically the same as those originally made, it is reasonnable to conclude that re-stocking has been ineffectual. If, however, the curve of the original locality becomes modified and approaches that of the second locality (that is, the locality from which the brood fish were taken), it is reasonable to conclude that the influence of the fish new to the locality has been felt, and that the re-stocking has been effectual.

The following objections may be raised to the method just given:

1. It may be that due to the small number of specimens, the curve represented on the first diagram is not really characteristic of the Woods Hole specimens.—To test this source of possible error, three separate groups of flatfish were examined, all from the same locality, and each group containing one hundred speciments. The resulting curves were strikingly alike. (Of course it would be much more satisfactory to base all the curves on the enumeration of one thousand rather than one hundred specimens, but even one hundred specimens evidently yield fairly definite results, though, to be sure, the curves are somewhat uneven.)

2. It may be that the variation in the position of the curves on the two diagrams is a result of age—i. e., the fishes from Woods Hole average a larger number of fin-rays simply because they are somewhat older. This possible increase on the part of the older specimens, if present, can readily be detected by simply comparing the average number of fin-rays of the younger with the average number of fin-rays of the older fish. Fifty-three young, *less* than ten inches in length, have a mathematical average of 66 dorsal fin-rays; forty-seven older fishes from the same locality, all *over* ten inches in length, average



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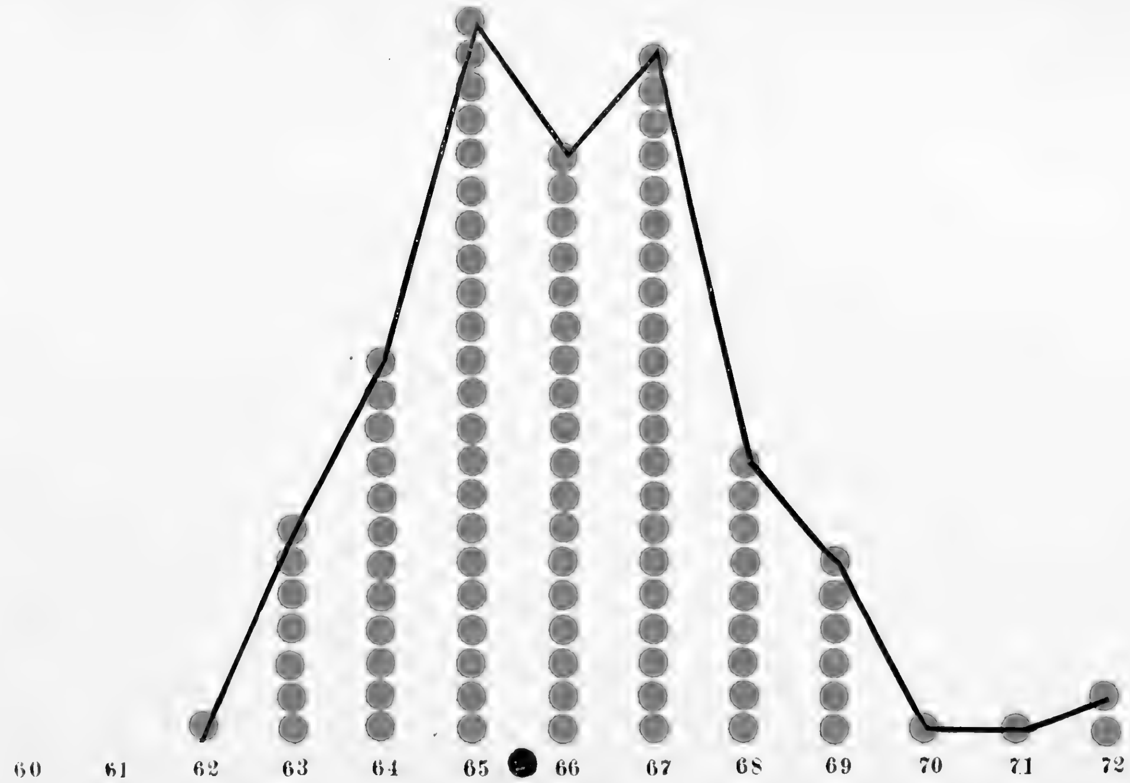


Woods Hole.

practically the same number. The question of age, then, does not enter in as a disturbing element.

3. It may be that the variations tabulated are the result of environmental conditions expressed upon the fry and young; they may be merely acquired characters of questionable hereditary value. In other words, it may be that the fry reared at Woods Hole attain to a larger number of fin-rays than the same fry would possess were they reared at Waquoit. While certain experiments that the writer has made induce him to believe that these variations in the number of dorsal fin-rays are really deep-seated characters and are *not* the result of environmental conditions, it must be remembered that if the variations are admitted to be the result of strange surroundings, the method is not necessarily thereby vitiated, for if it is insisted that certain external influences may affect the fry *after* liberation from the hatchery, and the results of these influences are expressed by a change in the fin-ray formula, it must also be equally true that the much more extreme an unusual environmental conditions imposed upon the still younger organism while *within* the hatchery will also leave their stamp, and the artificially hatched fish will thus present some peculiarity (acquired though it may be) which will be brought out by the plotting of curves of distribution.

Mr. Whitaker: What is your opinion, Prof. Birge, as to these structural differences spoken of and the ideas advanced in this paper upon that point?

Prof. Birge: It seems to me there is a chance for very valuable work just in this connection. The flatfish hav an enormous number of fin rays, so great a number that we should naturally expect the kind of local variation which the professor finds. Whether this would be true of the whitefish or lake trout or any of the fish of the Great Lakes, I dont' know, but it seems to me that there is a point the fish culturists might well investigate. I haven't very much doubt that somewhere or other there could be found some such difference between the Lake Michigan lake trout and the Lake Superior lake trout. If, as Mr. Nevin says, we have to go to raising Lake Michigan trout eggs and planting them in Lake Superior, it would be quite possible to determine whether the fish as they are caught were the result of planting or the result of natural increase.

It is almost always true with any species of animals from different localities, certainly when they are widely separated, that though when you take two or three of them and look at them you may not discover any particular difference, yet if you take enough of them from various localities the characteristics will come out in the average.

Mr. Whitaker: I have never given any attention to those differences, but I had supposed from my familiarity with fish and from reading Dr. Henshall's Book on the Black Bass, that one of the distinguishing differences between the large and small-mouthed bass was the number of fin rays in the dorsal fins, and the number of fin rays in the dorsal was of a constant character and that the number of rays was always the same in each individual.

Prof. Birge: The number of fin rays is characteristic for any species of fish, but the number is not absolutely constant. The spinous dorsal fin rays in the black bass are, I believe, 11 or 12. Where the number is so small you would expect to find little variation, although it might be possible that in the black bass from one locality you would find a larger proportion with, say 11 rays, than you would in those from another lake. If that should be found, it would be an instance of the same sort of variation that Prof. Bumpus finds in flatfish.

Mr. Clark: I would like to ask the professor why there should be this difference, why Dr. Bumpus should probably come to this conclusion that these were artificially hatched eggs.

Prof. Birge: He does not come to that conclusion.

Mr. Clark: In a sense he infers it.

Prof. Birge: No, you don't quite get his idea. Prof. Bumpus has simply taken these fish from two different localities as an illustration of what might be done to determine whether given fish are the result of planting or of natural increase. The point is this: Suppose that you breed from the fish at Wood's Hole and plant the young along the coast. Later you study the number of fin rays in the flatfish from the places where you have planted the fry. The average number of fin rays would show you whether the fish were the natural product of the locality or the result of planting.

Mr. Stranahan: I would like to add as to the general subject as to the shape of fishes that we have in northern Ohio two distinct forms of small-mouth black bass, I perhaps might say varieties, although our more scientific friends might consider even "varieties" too strong a word.

The ones in the rivers above the dams are longer, slimmer and more fusiform; those in the lake, which never enter the rivers, are shorter, broader, and more compressed.

There is also an intermediate between the two, partaking of the characteristics of both. These come from the lake into the mouths of the rivers and up to the first dam to feed and to spawn in the spring and to feed in the fall, and it is not improbable that they also hibernate there, as I have caught them there late in the fall on a warm day, after hard freezing weather had set in.

The pike-perch of Sandusky Bay is easily distinguished from its species taken about the islands in the main lake, being more fusiform and longer for a given weight besides being of a decided yellow cast, while the lake fish is broader, more compressed and the yellow shades almost or quite wanting. It may be interesting to state, in passing, that the pike-perch taken in the Lake of the Woods in Canada—many of which are brought to Sandusky to be marketed—cannot be told from those taken in Sandusky Bay by the commercial fishermen who are handling them constantly.

These differences are persistent to a well nigh universal degree, and perhaps might be worked out in the more minute structural lines as to fin rays, scales, etc.

Prof. Birge: Yes, they could be; the question would at once arise whether these differences are sufficiently permanent. For instance, you brought stream black bass into a lake, will they keep the stream form or assume the lake form?

Mr. Stranahan: You may stock a stream ever so well with black bass from Lake Erie and if they can possibly get back to the lake, they will get there. We know that by experience; the ones planted from Sandusky Bay planted in Chagrin river didn't show up at all. I should expect to see that hereditary disposition show up for one or two generations.

Prof. Birge: How is it about stocking lakes with stream fish?

Mr. Stranahan: They would go to the streams if they could get there; their hereditary disposition doubtless would carry them into the streams.

Prof. Birge: The professor has used for practical purposes, one of the newer methods in biology. One thing that biologists have been doing recently has been to get at the average of structure and to state the amount of variation from the average. They have begun to measure in a large number of individuals the main structural characteristics, which are capable of measurement, so that they can tell in a moment what the average is and how the animals distribute themselves within the range of variation. There is often a great difference in this distribution, so that while the average may be very nearly the same, and the amount of variation may be very nearly the same, the curves may be very different as in some of these diagrams. It seems to me that there is a point of very great practical value. I don't think very much of your matters of general form in connection with black bass and the shape of black bass. I think that would be too variable and too indefinite.

Mr. Clark: It is a fact that in the Great Lakes we can pick out fish that we are almost positive were artificially hatched, from the looks of the fish. Now, for instance, and I think the superintendents here will bear me out, we find in upper Lake Michigan and Lake Superior, fish that we at once say, is a Lake Erie whitefish.

Mr. Whitaker: There is no doubt about it and it has just the appearance of the Lake Erie whitefish as to its form, and general color. We, of course, as practical fish culturists, have not entered into this question of structural differences that you speak of. We distinguish the difference by the form and color of the fish.

Mr. Nevin: It is the same thing between the Lake Michigan and Lake Superior fish.

Mr. Whitaker: The work of the Michigan Fish Commissioners is a pretty fair practical test in the determination of that question. Our commission gets its supply of ova largely from Lake Erie whitefish. These fish are distributed by us all through the other lakes, and we frequently receive reports from fishermen which show there is a variation in form and color between the planted and indigenous whitefish which distinguishes them. They say "these are Lake Erie whitefish because they are different from ours;" that is, the difference is so marked as to be noticeable.

Mr. Nevin: In 1889 we planted about 10,000,000 whitefish in Lake Superior; in the last three years they have been getting them by tons and tons. Fishermen will go out and catch them in great quantities.

Mr. Stranahan: Mr. J. N. Dewey tells me that he catches fish at West Sister Island that are very different from the Lake

Erie fish. He says they are so different and distinct that the fishermen can readily pick them out. Fry of the black fin whitefish were planted there some ten years ago.

Prof. Birge: The counting of the number of fin rays is no very enormous job.

Mr. Stranahan: Don't they have to dissect them?

Prof. Birge: No, simply spread out the fins and count the rays.

Mr. Bower: It seems to me that this discussion has developed the fact that we have too little faith in the fish we turn out from hatcheries. When young fish are returned to indigenous waters I challenge anybody to give a reason why there should not be as good results as from those hatched in the natural way. When we can take shad from hatcheries, transport them across the continent, and plant them into waters where the species had never existed, then contemplate the remarkable results that have followed, our faith in the work of planting fry rests on the solid foundation of proof of results. We didn't need to identify the first adult shad that appeared in the bays and rivers of the Pacific coast, nor was it necessary to identify one trout in hundreds of streams in Michigan. The simple presence of these fish was proof indisputable that they grew from planted fry. Should not our faith in the work of planting fry in strictly native waters be strengthened rather than weakened, in the face of what planting in non-native waters has accomplished? And should we not feel entirely confident that as large a percentage of fry so planted survive to maturity as from the wild fry, whether we shall ever be able to identify one from the other or not?

Mr. Whitaker: The point made by Mr. Bower has been proven repeatedly. I don't think you need to argue to fish culturists that artificial propagation has not been a striking success in the stocking of waters. The great success that fish culturists gain by their methods is gained by the isolation of the ova from natural enemies until the eggs have hatched. Up to that point you have minimized the loss. We have in Michigan the finest river in the world for brook trout fishing and that stream was first stocked with trout in 1879. I intended to have brought some data I have as to the immense number of trout taken from it in one year, given me by Salling, Hansen & Co., of Grayling, Mich. They arranged with the boatmen on that stream to give them an estimate of the number of fish taken on the stream, during the season. I cannot state the number because I don't remember, but it was perfectly marvelous. The river contained nothing but grayling up to 1879, when our commission began stocking it with trout, and the results of that work establish beyond doubt the efficacy of artificial propagation. I wish to endorse what Mr. Bower said regarding the stocking of Pacific slope streams with shad and its success. There is an interesting thing to fish commissioners in connection with that work. Col. McDonald took occasion at one time to write a monograph on that work which was very interesting. He stated that the Japan current sets in towards the coast of California, and because of the temperature of that stream instead of the shad only returning to the rivers where planted they have distributed themselves northward in tidal streams for hundreds of miles. They have stocked those waters so thoroughly, from the small plants made, that Mr. Blackford when in San Francisco a few years ago sent a dispatch to this society at a meeting held in New York, stating that the number of shad on the market in San Francisco was so great that they had to avoid glutting the market by regulating the catch, and that the shad were larger in size and greater in quantity and cheaper in price than in the New York market. It is the same with the striped bass and neither one of these fish were indigenous to the streams of the Pacific coast, but were the results of planting.

Mr. Clark: Perhaps the members of the society will think that after a life of thirty years in practical fish culture, I am losing faith in the work of the fish culturist, if I say nothing at this time. I want to put myself right and straight on the matter. I am just as strong in the faith as I ever was. Speaking of the work of transplanting shad from the Atlantic to the Pacific coast, I will say the United States Fish Commission made these plants—and I don't like to say that I was one of them, but I was. Outside one small plant, the plants of shad carried to the Pacific coast were carried there under my direction; that is, I had charge of the trips up to the time that the fish were sold in the San Francisco market for five cents apiece. I carried all the fish to the Sacramento River except five thousand; therefore, I ought not to lose faith in fish culture.

Mr. Whitaker: Do you remember about what the aggregate of the plants of shad was?

Mr. Clark: Six hundred and forty thousand made in three different plants, outside the plant made by Mr. Greene. In 1876 I took through, with Dr. Bean as my assistant, 200,000; in 1877 I took through 200,000, in 1878 I took through 200,000. If the gentlemen here had seen Dr. Bean and myself trying to take through the first 200,000 they would have thought we were lunatics. The report was that it was not possible to transport them in a baggage car in cans unless you could keep the temperature above 72. In going over the mountain in summer time in June, we found pretty cold weather in the night time. There were snow storms and we built a fire in the stove. We could not warm up the water; it kept going up and up and at last we took our coats off and rolled up our sleeves and ran our arms down into the water and tried to warm the water. We pulled off our shoes and stockings and put our legs in and tried to warm the water. It ran down and down, but we succeeded in carrying through to San Francisco a lot of the finest shad I ever saw.

Mr. Bower: I wouldn't have it understood for a moment that I belittle the kind of work spoken of by Prof. Bumpus, but what I do want to say is that I don't believe in the necessity and don't understand exactly why fish culturists should need to have documents of that kind to bolster up their faith in fish culture. We don't need to have our fish identified before we are satisfied that we are getting good results.

Prof. Birge: It seems to me that Mr. Bower has understood this paper differently from what Prof. Bumpus intended it should be understood. I don't understand that we are arguing that the work of planting fish is not practical, but there are a great many people, and gentlemen of intelligence, who say, how do you know when you put fish in Lake Erie, for instance, what becomes of them? How do you know they have come back again, that they don't go away, or how the fish increase, or that these are not the fish that came in from the natural breeding grounds? You can answer the question and perhaps prove it and no doubt you can, in many cases, convince the man you are talking to that you are increasing the fisheries in that manner, yet if you can have a definite and positve answer it would be better. The more positive proof you have, it seems to me, the better.

Mr. Spencley: It seems to me there is a great deal of difference between faith and proof. Mr. Bowers says he has a great deal of faith, that is all very true; I don't believe any person present at this meeting has any doubt about the success of fish culture, but as Prof. Birge has said, sometimes you have got to prove it.

We have had some difficulty in Wisconsin. We have been telling people that we have been planting whitefish and that they have been increasing in numbers; some of these people will say, I don't believe you, you haven't got anything to prove it. You cannot convince the average fisherman against his own will. Several years ago Mr. Nevin took inland fish and put them in Lake Superior; they produced an entirely different kind of fish, so that the fishermen then had to admit it. There was the proof and the fishermen of Lake Superior now admit that fish culture is a success. I think this paper is in that direction, it is to get proof so that it will satisfy everybody and will give them the proof that fish culture is a success. I think he has tried to demonstrate in another way that it can be shown by proof that the artificial propagation of fish is a success. It is simply in the same line as these experiments with the Wisconsin fish.

Mr. Whitaker: If there is no further discussion on this paper I beg the indulgence of the society for a few moments. We have with us a citizen of Omaha who is seeking information about fish. He is making some experiments which he desires to have a little advice upon. He proposes to do some work in fish culture in connection with artesian water. He is the Surveyor of Customs of this port. I have the pleasure of introducing to the society Dr. Geo. L. Miller, of Omaha.

Dr. Miller: Gentlemen: This is an agreeable surprise to me. I saw the notice of your coming among us and I took an immediate, personal and selfish interest in it as well as a public one. It is indeed a very great courtesy that my friend suggests that I should say a word in a convention of this importance, devoted to prepared papers and on fish culture.

I take advantage of the opportunity to say that I am, from my nativity and the associations of my boyhood, a lover of fish. Where this younger man (referring to Secretary Whitaker) first saw the sunlight and with the streams with which he was familiar, I have been familiar in a long and active life, the Northern Adirondacks. We were both natives of New York, you of Lewis and I of Oneida. I have resided here since this was a white settlement, for more than forty years. I came in here to hear suggestions from you on a subject in which I am interested. Mr. Ravenel, of the United States Fish Commission, has been very polite in making suggestions to me about a lake which I have of forty acres. I began without any scientific knowledge to put in breeders, and through the courtesy of Mr. May I put in some young trout and some old ones. I had hopes I could exclude all other fish, but to my utter astonishment the selections were not properly made, and I find I have all sorts of fish, peculiar and indigenous to the country. Mr. Ravenel told me that the rainbow would probably live in a temperature of 60, but for the reason that the water would become warm very soon after coming out of the artesian well, which is about a thousand feet away, I didn't venture to risk it. What I have come here to find out is, whether I could risk putting the rainbow in that water that is fed by water of 60 degrees temperature?

I would like to know if bass are cannibals. As I say, it is a purely selfish interest on my part, outside of a public one. I have raised bass from breeding to a pound and a half and a pound and three-quarters, and I have had two or three thousand fish taken out of there by fishermen.

I want to know another thing, if some gentleman will give me the information, whether bass are in any danger from bullheads and carp? I also want to know whether I am in danger of overstocking this forty acres of water which has neither inlet or outlet. I want to know what proportion I can expect to raise from breeding, and whether I am in danger of overstocking this place and making it an offensive place.

Mr. Peabody: We have a number of gentlemen who can give you a great deal of information. You will find out a great deal of that information from books written by Dr. Henshall.

Mr. Whitaker: I think the society is to be congratulated in having just such questions proposed. It touches the practical side of fish culture. I felt when I introduced the doctor, that the society would be very glad to hear from him. He has suggested enough to warrant us in giving him some information, if we can. I think there are those here who can give the information he asks for. I want to say that I had prepared a paper touching on this very point, but I find I have left it at home. It touched on the question of overstocking waters; it touched on the question of the proper places in which to plant fish; it touched on the question of the attempt to exterminate native species from lakes by netting. Very many people feel that they would like to know whether they can take a given water and stock it ad infinitum and make a success of it. I suppose it is a pretty well established fact that nature sets up a pretty correct natural balance between varieties of fish in all waters. Many of the states have beautiful lakes to which people resort for summer homes. Those lakes may have been naturally stocked with black bass, but the persistent fishing of a dozen or more anglers for four or five months in each year, with the spearing that goes on at other times, has in course of time depleted the waters of bass. The next thing that we as commissioners hear is an application from the denizens about some lake for a permit to net out the suckers, which they say have grown in numbers enormously, and they believe the suckers are killing the bass. This is not so. The bass is a fighter who will maintain himself against any other fish of even greater size. In no case should the attempt be made to destroy the sucker, which is prime food for the bass, or the carp, which is also fine food for the bass. If I had a private water in which I wanted to raise bass, I would see to it that a certain number of carp were put in there as food for the better fish, and they wouldn't hurt at all if you can keep them in control.

Again, we hear someone say, I have a magnificent stream, I want 50,000 or 150,000! brook trout put in that stream at its source. That is the poorest place that could be selected. Plant them away from the source; put them in ponds made along the stream. You there give opportunity to the insects to deposit their eggs, which are fish food. In time you have natural food that will to a great extent support fish life. You may overstock a stream or lake, and if you do so, in time you will have a generation of runts. You must avoid that. If you do it your fish will be undersized, and that is the case with many clubs who have overstocked their waters in their anxiety to increase their stock.

Dr. Miller: Would you leave the carp in the water?

Mr. Whitaker: You cannot get them out after they are once in.

Dr. Miller: Would you keep them reduced?

Mr. Whitaker: Yes, and I would reduce them by putting in enough bass to keep them down.

Dr. Miller: How about the bass eating one another?

Mr. Whitaker: The bass is supposed to be one of the very few fish that takes care of its young. They select a place for nesting and lay their eggs, and guard them from their enemies.

Dr. Miller: I think that Mr. Henshall states that after they leave their nests they eat each other.

Mr. Whitaker: Large fish will eat small ones under all circumstances if they get a chance. The fish culturist learns that in his practical work. You have got to separate fish of different ages as well as you can, to prevent it, when held in ponds.

Mr. Stranahan: The black bass won't prey on their kind if they have an abundance of other food. I believe it is of more importance to you, Dr. Miller, with your area of water, to see to crossing your fish with new stock than it is to look after the carp. I have had some experience with much larger ponds than yours where the stock has become diminutive through inbreeding. I should say it would be the best thing to introduce every year a new stock of bass; if you don't, you will get a diminutive race.

Mr. Peabody: There is a club in Indiana that has taken up the subject of producing bass artificially. They have two artificial ponds in which they keep their bass, and another in which they carry on the hatching. In the small one they keep the bass until they get large enough to be active; then the club takes all the larger ones and puts them out. They have a drain in the center of this pond by which they can draw the water all off. Then can go into it and take out all the fish. They have met with such success that they have their larger ponds amply stocked. They do this all in an artificial way.

Dr. Miller: I wish to state for the information of the gentlemen that Mr. May, the honorable president of your convention, is the gentleman who started me in my enterprise, with this result, that this year out of my lake there have been caught, I suppose, two or three thousand bass by hook and line. This spring I put in twenty breeders and I don't know how many young bass there are, but the lake seems to be alive with bass. I came here this morning without an invitation. I felt that I was somewhat at home with fish men. I came in to see about some things that have been answered by my friend from Michigan—originally from New York. I was told that I was in danger of overstocking this lake. I thank you, gentlemen, for your kindness. I can now go home with a good deal of light upon the subject I wanted to be enlightened upon.

President May: The next paper in order is a paper by Mr. O'Brien.

Mr. O'Brien then read the following paper:

LARGE-MOUTHED BLACK BASS.

Methods of Hatching and Rearing.

A great deal has been said and written, at former meetings of this society, on bass culture, by persons of much greater ability than myself, therefore do not expect an elaborate essay from me. But as we departed somewhat from the usual method of handling our bass spawners at the Nebraska hatcheries the past season, possibly my experiments and the results obtained will prove of interest to those engaged in this branch of fish culture.

Our main spawning pond has a surface area of about one acre and, with the exception of the kettle, or drainage point, averages about two feet in depth; bottom being both mud and sand.

Previous to the spring of 1896 it had been the custom to place the spawners in the pond as soon as the ice melted off, together with a large number of chubs and shiners to serve as food and pay no more attention to them until the pond was drawn off in the fall to remove whatever young bass there might be. This haphazard manner of propagation, of course, resulted in rather indifferent success.

In the spring of 1896 I used gravel spawning beds with brush shelter and removed a large number of the fry to another pond when about a month old and fed ground crayfish with considerable success.

The spawning season for bass, in our ponds, extends usually over a period of about six weeks and I noticed when we transferred the fry there was a great difference in the size of some as compared with others and after the fry was moved I noticed that although I fed an abundance of ground crayfish, and there was considerable insect life in the pond, the larger fry preyed on the smaller ones continually, diminishing the number to a considerable extent.

In the spring of 1897 I decided to change the method of handling the spawners entirely; instead of transferring them from the winter pond to the spawning pond when the ice melted off, we placed the spawners in a pond that had previously been used for trout where temperature was about 55 degrees.

We then drew off the water in the spawning pond about the 1st of May and allowed it to remain dry for ten days. We then placed eight wagonloads of mixed fine and coarse gravel on the bottom of shallow portions of the pond, in spots or beds about eight feet square and about two inches deep. We also put in twelve spawning boxes made of wood three feet square with sides three inches high and filled with gravel. The pond was then filled with water and willow brush laid in V-shape, the butt ends of the brush being crossed at the pointed end of the V, being placed around each spawning bed, forming a perfect enclosure.

Willow brush with the butt ends sharpened and stuck in the bottom of the pond was also placed around the spawning boxes to afford seclusion for the spawners.

May 29th the spawners, 42 in all, about an equal number of males and females, were transferred to the spawning pond; the temperature in the pond being about 66 degrees, a change of 11 degrees from the pond from which they were transferred; the spawners were put in near the inflow pipe and the change of temperature did not seem to affect them in the least, but as I had expected, it caused the ova to ripen rapidly and within twenty-four hours they began to pair and spawn, and in nine days from the time they were placed in the pond the last pair had spawned; out of the whole number only two pair used the spawning boxes and one pair spawned in open water on fine sand.

The eggs hatched out in eight days and when the fry were about a month old I transferred what I estimated at 20,000 to an adjoining pond, collecting them with a one-eighth inch mesh common sense minnow net, the most of them being taken about sundown around the inflow pipe.

In the same pond with the fry I placed a large number of eyed carp eggs, laid on moss, the carp when hatched to serve as food for the young bass. This experiment proved a failure, for within a month the carp had grown so rapidly that they were as large as the bass and were destroying all insect life and making the water very muddy.

Wooden boxes two feet square with slat sides one-half inch apart and supported by stakes driven in the bottom of the pond were then placed at different points in the pond and ground crayfish placed in these fed for the balance of the season, but the carp kept the water so roily that the bass did not seem to thrive and when the pond was drawn off in September less than fifteen per cent. of the number placed in the pond were found.

The original spawning pond was well stocked with chubs and shiners, which spawned about the same time as the bass. About the 1st of August I partitioned off about one-third of this pond near the inflow pipe with one-inch mesh galvanized wire fencing, supported by stakes driven in the bottom of the pond and extending ten inches above the surface of the water, this fence being put in to allow the young bass to feed on the minnow fry undisturbed by the parent bass. The bass in this pond thrived beyond my expectations and when the water was drawn off in October I removed over 33,000 young bass of an almost uniform length of three inches, not to exceed 30 oversized fish being found among the whole number.

The uniformity in size I attributed entirely to the fact that the fry were all hatched at practically the same time and I believe that if bass spawners were held in water of a low temperature until about the 1st of June and then placed in spawning ponds where the water is several degrees warmer, so as to ripen the ova rapidly and thereby shorten the spawning period, that much of the loss and annoyance caused by oversized fry would be avoided.

Although the experiment in feeding the carp fry to the young bass in the pond proved a failure, yet I am convinced it would be possible to keep carp spawners in water of a low temperature to prevent them from spawning until late in the season, allowing a few pair to spawn at intervals as needed; this, I believe, would prove a cheap and easy method of feeding bass fry in troughs or small ponds where the number of carp fed could be completely controlled by the attendants.

Mr. Stranahan: With reference to this matter, I will say that experiments have been made in France, also in this country by the United States Fish Commission in Washington, to retard the growth of carp. It has been found very successful. Mr. Ravenel told me that the results were very gratifying by withdrawing the food.

Mr. Clark: From Mr. O'Brien's paper I see that he is an advocate of the partial rearing of fish, and that brings us back to the old question that Mr. Whitaker, Mr. Mather and myself fought over so many years ago; the question of yearlings. I think, if I am not mistaken, they dubbed me the "Father of the Yearling." I will say I don't want to bring that question up now, but I am still an advocate of it, but not for bass. If the gentlemen that have been raising bass will take the pains to examine them minutely with the microscope they will find that a young bass one week old is as mature a fish as at five years old. For that reason I am an advocate of planting the fry of the bass. I think when it is thoroughly investigated it will be found better to plant the young bass. I want to put myself on record as an advocate of planting bass fry. If you plant them broadcast in lakes and rivers they can spread out more. It is a more difficult thing to find artificial food for young bass than for other fish.

Mr. Oberfelder: As far as the United States Commission is concerned, I presume it is all right to deliver fry, but when the people who pay for this work are sent the fry they don't think they are getting any fish. The Nebraska Fish Commission are trying to deliver pike six months old; I think the people throughout the State would be better satisfied with the delivery of such fish to them than the fry. They might not from the standpoint of the United States Commission. I know the commisisoner of Wyoming told me that they sent trout last year in cans, saying "there is 5,000 trout in a can," but those who received them said it was the same old fish story; we counted them and found there were but 850. After this they say we want more yearlings and no more fry.

Mr. Whitaker: I don't suppose there is any way by which you can guard against misrepresentation as to the number of fish that are put in cans. I think it is poor policy on the part of a board, and I think they will find that misrepresentations of that kind must ultimately come back to them injuriously. It is not policy, if you want to put in on the ground of policy. It is not honesty, if you put it on the ground of honesty.

So far as not getting results from the distribution of the fry is concerned, that may be as stated in the State of which the gentleman speaks, but it is not so in Michigan. The great and successful work of stocking there has come solely from plants of fry. There is this to be said, in my opinion, that notwithstanding the fact that the planting of fingerling and yearling fish has been advocated in this country by some for ten or fifteen years, the planting of fingerling fish has not made perceptible headway anywhere and the large work of distribution is still being done with fry.

Mr. Clark: And always will be.

Mr. O'Brien: I don't wish to be understood as advocating the planting of fingerling or yearling fish. I just merely mentioned the fact that we are rearing our bass to an age of six months. It is not done because we thought that fingerlings or yearlings were more successful, it was more because we thought we could transport them with greater safety at the age of six months. That is the reason I should put out the bass in the fall. We have hot weather in June and July, and we are not as well fixed to carry fish as the United States Fish Commission.

Mr. Clark: I don't wish to prolong this discussion, but I want the members of this society to understand the point. I don't care to bring in the yearling question, but the point is, that the black bass is a fish that should not be held and reared, because it is not necessary; because at the end of a week or two weeks they are just as mature as they ever will be.

Mr. Bower: You mean in appearance.

Mr. Clark: Yes, just as well able to take care of themselves as they will be in a year.

Mr. Oberfelder: How about pike? Do you think a pike a week old is as good as one six months old?

Mr. Clark: I have had no experience in the rearing of pike.

Mr. Peabody: I understand you are in favor of fingerlings and yearlings as to trout.

Mr. Clark: I will say I stand just where I did ten or fifteen years ago. In answer to what Mr. Whitaker said and he perhaps didn't wish to be understood just exactly as it sounded, that the yearling theory has not progressed, I wish to say that arises from the fact we cannot raise enough. We can only keep two or three hundred thousand at any station. There is no station in the country large enough to raise a million yearlings. The point is to raise what you can, and as to the balance distribute fry.

Mr. Nevin: Do you mean that in relation to lake trout?

Mr. Clark: Yes, I do.

Mr. Peabody: I am glad to hear you say that. Last winter I talked with the New York people and they are strongly in favor of fingerlings.

Mr. Whitaker: There is no probability, so far as the results are concerned, if you will watch them for the next ten years, that you will find any great increase in their output of fingerling trout. It is impossible, with the multitude of streams we have, taking the great comparative cost of planting fingerlings, to stock the streams of this country with fingerlings.

Mr. Stranahan then read his paper, which follows:

THE MICROSCOPE AS PRACTICALLY APPLIED TO FISH CULTURE.

Prefatory to this paper the writer would say that no one with ordinary intelligence should hesitate to make use of the microscope in fish culture because of any fear that he may not be able to master it.

It is very simple and by the perusal of any one of the many good books of instruction on the use of the instrument, and a little practice, its mastery will come to you with surprising rapidity, and your interest will goad you on until you will find your back and eyes aching, and glancing at your watch, you will dash off for your dinner, conning over some good story on the way to tell your wife as to what made you late.

The most important work of the microscope in practical fish culture is, doubtless, to determine the condition of eggs soon after they are taken so as to remedy early any errors of the spawn-taker which may exist and thus save unnecessary loss.

In examining eggs under the microscope I use a cell that holds about a certain number of eggs, as for instance, in the case of the whitefish my cell holds twenty eggs in a row and five rows deep, making in round numbers 100 eggs, although eggs vary so much in size that this is not absolute.

In making an examination the eggs which are impregnated, unimpregnated and those with ruptured yelks are so easily detected, one from the other, that the cell may be moved under the microscope as fast as you can count.

It is the practice of the writer to examine whitefish and cisco eggs twenty-four hours after they are taken, when segmentation is at its most distinct period. The disc of the impregnated egg will then be found divided into some fifteen or twenty cells, nicely rounded into nodules looking under a half-inch objective as large as kernels of corn. The disc of the unimpregnated egg will be an almost perfect hemisphere and will present a much clearer appearance than the impregnated one. The eggs with ruptured yelks will present a varied appearance. Generally the albumen will be in a layer at the bottom, the oil globules at the top and the disc, much distorted and out of all semblance of the normal, floating between the two. There is another class of valueless eggs, those containing no germinal disc at all, but they constitute a very small per cent., and as, of course, no amount of care on the part of the spawn-taker could put life into these, they need not be taken into account at all.

Thus it will be seen, the eggs at the station can be examined each day, each lot separately, and a record of the work of each and every spawn-taker kept, his errors corrected or the man discharged, and by going over your tables resulting from this work, when you are about to engage your spawn-takers for a season, you can see at a glance who are your best men, weed out the poorer ones and greatly improve your spawn-taking force. Of all occupations, a careless, negligent, dull spawn-taker is the one to be avoided. He should be intelligent, progressive, obedient to orders and as such, should be paid well for his services and retained from year to year.

About seventy-five spawn-takers are employed at the Put-in-Bay station each fall, and it will be apparent to the most casual observer that this plan of examining eggs must result in the securing of a much larger number of good eggs than would otherwise be the case.

The great advantage of the microscope is that you can determine in twenty-four hours whether your eggs are good or not and apply the remedy, while without it, especially in the case of unimpregnated eggs, you have to wait until the season is nearly over before you know the result, and in the meantime you have, perhaps, lost millions of eggs which should have been saved. The writer frequently uses the telegraph in calling delinquent spawn-takers to task and believes that it has paid well on the investment.

Aside from examining eggs to determine their quality, the microscope can be made of use almost daily while eggs and fry are in the house. Many little emergencies arise when you wish to make a closer examination of eggs or fry than you can make with the unaided eye, and it soon becomes a second nature to resort to the microscope.

To illustrate: At the Put-in-Bay station one morning last April, it was discovered that the pike-perch eggs were so light in the jars that it was difficult to keep them from flowing out, although the water had been shut down to a considerable extent. The microscope revealed the fact that colonies of infusoria—mainly the species Carchesium, with a few Vorticella—were so common that it was difficult to find an egg without one or more. The eggs were thoroughly feathered, thus breaking off the slender stems by which the animals were attached to the eggs, when they worked as well as ever and no harm was done further than that incident to the handling of this very tender egg. I will state, incidentally, that this phenomenon had never occurred before at the Put-in-Bay station and I have never heard of it elsewhere.

As is well known to fish culturists, there is a small loss among all kinds of fish eggs after the embryo has formed, what is called in ordinary hatchery parlance "deadeyed eggs." The microscope will be found convenient in studying the cause of this loss. In the whitefish eggs examined by the writer the past season it was found that about 30 per cent. of this loss was occasioned by insufficient food supply, that is, the yelk sack being undersize, the albumen would become absorbed when the embryo would starve to death. This loss goes on from the early formation of the embryos up to the time of hatching, those with the smaller sacks dying first and the others later on.

Malformation causes about 20 per cent. of the loss, beginning early where the embryo is very poorly organized, perhaps having merely the semblance of an organization, with the abnormal brain and a rudimental spinal column and yet with a heart and a system of blood vessels. The eyes in these more erratic forms are usually wanting, and if present are very imperfect, these organs being among the first to show malformation, while the auditory apparatus is among the most perfect.

About eight or nine per cent. of this loss is caused by ruptured yelk sacks, ruptured blood vessels and aneurisms.

With about 40 per cent. of this loss the writer was unable to arrive at the cause. His work was all done in gross, not having a microtome or other appliances for making sections, and not being sufficiently versed in the work to have made use of them if he had been thus supplied. It is probable that one well versed in the various sciences called into action in this work and with better appliances could determine the cause of death in the greater portion of this remaining 40 per cent.

The writer has come to the conclusion that, as in the higher forms, nearly all this loss is the natural weeding out of the more weakly individuals, through that inexorable law which provides for the survival of the fittest, and it therefore follows, if this be true, that no amount of care on the part of the fish culturist can do more than cut this loss down in a small degree. It is probable that care in taking and handling the eggs would reduce the number of malformations and ruptured yelk sacks to some extent, but in the main the death of eyed eggs results from natural causes, which no amount of care on the part of the fish culturist can prevent.

The writer would recommend that fish culturists use the camera in connection with the microscope and thus place the results of their labors in a more permanent form.

With a reasonably good microscope and any camera which has facilities for handling dry plates, photo-micrographs can be made by removing all the lenses from the camera, which can be connected with the microscope either perpendicularly or horizontally according to the egg, whether best viewed from side or top.

and some simple appliance arranged for excluding the light at the union, or, if the lenses of the camera are good ones, they may be left in and better results be thus obtained. The writer pursues the latter course with better results than with the former. When the mrcisocope is well focused the camera will be, no matter whether the bellows be drawn out to the fullest extent or short-focused, the only difference being the size of the picture.

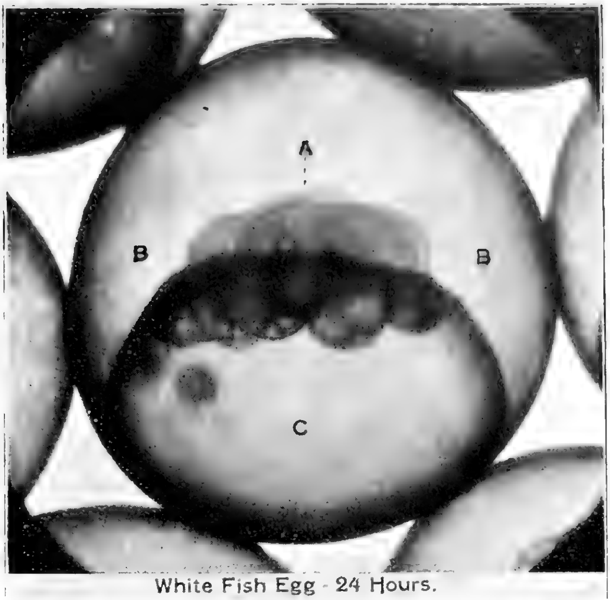
From half a minute with a Welsbach gas burned to five minutes, or a little less with a coal oil lamp will be found within reasonable range for time of exposure but this will have to be determined by individuals by experience.

Quick plates should be used, and Metol developer will be found to be the most effective, giving a wide range, and being especially good where the plate is under-exposed, very likely to be the case where the embryo is sufficiently developed to move in the egg or with fry while alive.

In conclusion, I would say that the making of photo-micrographs is not nearly so difficult as most people suppose and that it can be readily mastered by calling a little perseverance and patience into requisition.

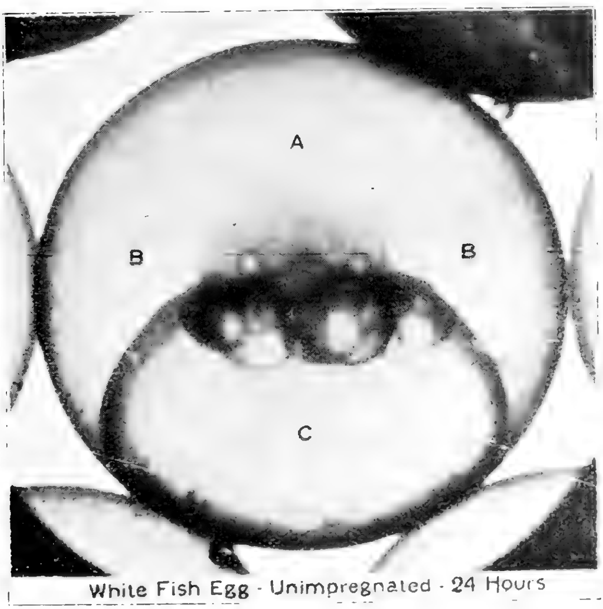
Mr. Whitaker: I want to say a word in connection with this paper, as it seems to me to have great practical value in connection with the stripping of fish. I believe that strippers become ultimately overconfident of their ability and become careless in their work and need just such a correction as this examination by the microscope will give. I think that the percentage of poor ova is due very largely to this overconfidence and poor handling of fish in spawning time. In a manual recently issued by the United States Commission there is an excellent article about the careless handling of fish in spawning operations. It appealed to me to be a very just criticism. It is the rough handling, to a certain extent, that causes the large loss of spawning fish at that time. This use of the microscope as applied by Mr. Stranahan seems to open to the practical fish culturist a very wide field. It is greatly to the credit of Mr. Stranahan that he has taken this work up in the way he has and I imagine in the next few years, if it is pursued by others, a great deal of good will result from its use.

Mr. Nevin: The way we keep track of our strippers is to have our boxes numbered, a number being given each stripper, and we keep track of his eggs; we send notice to the man if his eggs are poor, and if he does not improve we drop him.



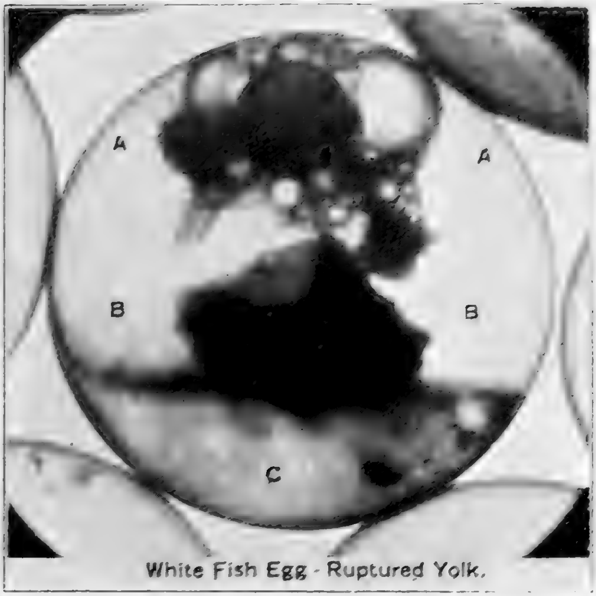
Impregnated Whitefish Egg, 24 Hours after Taking.

A – Germinal Disc, showing Segmentation.
B – Layer of Oil Globules.
C—Yolk Sac. (Magnified 21 diameters.)



Unimpregnated Whitefish Egg, 24 Hours after Taking.

A—Germinal Disc, Segmentation not having taken place.
B—Layer of Oil Globules.
C—Yolk Sac. (Magnified 21 diameters.)



WHITEFISH EGG, 24 HOURS AFTER TAKING, SHOWING YOLK SAC RUPTURED BY CARELESS SPAWNTAKER.

A. Oil Globules.
B. [illegible] Germinal Disc.
C. [illegible] Ruptured Yolk.

Magnified [illegible] diameters.

Mr. Stranahan: In that case it takes all the way from four or five days to two weeks to determine whether the eggs are fertilized or not, so you may lose by the carelessness of the spawn-taker, a million eggs, while in this way it is determined at once and he is notified by telegraph.

Mr. Bower: I used to be associated with Mr. Stranahan at the Put-in-Bay hatchery when we didn't use the microscope. I am thoroughly convinced that from what he has learned from the use of the microscope, he has got anywhere from 15 to 25 per cent. increase in hatch. That shows that the microscope is of great practical value.

Mr. Clark: I was rather skeptical on the question of the use of the microscope as applied practically, until I visited Put-in-Bay and witnessed its operation. I was instructed to proceed on the same line; I visited Mr. Stranahan's station and Mr. Stranahan showed me how his observations were conducted. I supposed it was going to take him a long time to do it but it did not take more than two minutes before he had figured out what the percentage of loss was and in about five minutes he had the eggs transferred to a photographic plate and in about twenty minutes he showed me the photograph. Any superintendent can do it; it is a very practical thing, especially with whitefish and lake trout eggs. I propose to take up this work, but I didn't get it in time last season to do so.

Mr. Gunckel then read a paper entitled "Fish Culturists," which follows:

THE FISH CULTURIST.

Generally speaking, scientific men, men whose knowledge upon any specific group of objects has been gained by systematic observation, experience, and reasoning, become so absorbed and lost in their work that the public seems to lose interest in them, and they in the public; the latter only appreciating and enthusing when the results have been obtained. The botanist will introduce a new peculiar name, and look serious as he carefully analyzes each sprig, leaf, flower, but the world only cares for what is of personal interest, of pecuniary gain, or of pleasure, and sees only its outward beauty, and praises its rich fragrance, and no one cares whether it comes from the Ladrones or the bottom overflows of the Missouri. So in like manner it can be said of the history of the science of physiology, of chemistry, astronomy, modern electricity, which has harnessed the most potent force of nature for man's use; and of the other sciences of equal importance, requiring deep thought, experience, and seclusion. But to no science can nature claim a closer alliance than the science of fishes. Its branches leading us nearer to nature and thus closer to humanity. It directly appeals to all the finer senses, and the pursuit of its objects leads us into many pleasant places, among the most beautiful realms of God's earthly kingdom.

As the population of the world increases, the demands upon the land and water resources naturally increase. The buffalo, the deer, the wild pigeon, dozens of other American game, are almost numbered with our animal curiosities, and no one has ever suggested a way to replenish the forests. Once gone, forever gone. But when our streams are robbed of food life, our commercial fishes driven from our shores with certain species now almost extinct, the fish culturist finds no trouble in restocking, and in many instances better than before. The grayling, that most beautiful of all inland fishes, almost extinct, in the fish hatchery department of the Trans-Mississippi Exposition you will see young fry by the thousands perfectly at home and but recently brought into this world by our careful fish culturist, soon to be planted in their native Michigan streams.

Since the first meeting of this society on December 20th, 1870, to the call for the present session, men have earnestly devoted time, study and money in devising ways and means, not only to protect the fishes of common waters, to replenish the depleted inland streams, through natural and artificial processes, but to introduce new species. The salmon rivers of the Pacific slope, the shad rivers of the East, and the whitefish fisheries of the lakes are now so thoroughly under the control of the fish culturist that it but remains for the Government of the United States, and each State individually, to give them the same unlimited authority as are given to other sciences of less importance.

Fish culture has been practiced from very early ages. It appears to have been in use in ancient Egypt, and was followed in China, but it was confined to the propagation and rearing of young fish in artificial ponds, with the view of introducing fish not previously found in the locality, or of increasing the supply of desirable good fishes. We find in the Smithsonian Report, 1880, page 149, the following: "The first honor prize, the gift of the Emperor of Germany, was awarded to Professor Baird, as a personal tribute to one who is regarded in Europe as the first fish culturist in the world." As a result, to-day, salmon and trout ova sent from Great Britain have been successfully hatched in Australia and New Zealand.

The great problems that the fish culturists had to meet, and to solve, were first, to prohibit wasteful or immoderate fishing, to aid in maintaining a natural supply. It was soon found that the States made no laws to protect that were really good, until the legislators were of the decided opinion that the fish were nearly all gone. When fish, as a nutritious and nourishing food, became more generally appreciated, it was found necessary to resort to the art of fish breeding to increase the supply beyond the natural limits, rapidly enough to meet the necessities of a constantly increasing population.

If our law-makers will carefully examine the fisheries exhibit of expositions, and particularly the present Trans-Mississippi Exposition, now open to the world, in this beautiful Western city, I am sure they will learn many things of great importance, and feel forever friendly toward the fish culturist, and return home convinced of the necessity of furnishing the people with good fish food, something more substantial than the results of political feuds. As near as I could examine the exhibits, with limited time at command, I am glad to say that those with whom rests the honor and responsibility of its careful preparation and complete representation of a fisheries exhibit, should feel proud that their work is so well done and so complete. As near as possible it embraces the greater part of the subject of the preparation of the fishing products, so particularly interesting to our fresh-water people, and the products themselves, including fish culture and scientific study of the matters relating thereto. There is no exhibit so attractive, and retains the American visitor so well, as an exhibit of live fish. There is no other exhibit at the Omaha Exposition where one is compelled to either elbow his way through the crowd or wait patiently his turn, as the fish exhibit. Hence the importance of improving this exhibit whenever and wherever opportunity affords. It's an educator. It proves a most instructive object lesson to all.

International exhibits give a good opportunity to review the work done in different branches of human activity. To the fish culturist it exhibits the results of his work as can be done in no other way, leaving a lasting, profitable impression upon the minds of the public.

It has been said that Europe originated and developed the various methods of carrying on fish culture, but it becomes an industry only in America, and a very important one from the standpoint of the Government. America within the past few years has done more scientific work, to find out the secret of nature's workings and to bottle Spanish mackerel, than in any year of its history. Limited as may seem the work of the American Fisheries Society, the people owe to the individual members of his Society a debt of gratitude for the efficient work, the complete and thorough knowledge of how to supply the increasing demand of our people for more fish food, the solution of the secret of fish propagation, the adaptation of waters to the various species of fishes transported from one country to another, and so complete will be the work that our inland streams will be stocked with fish from the Philippines and other countries now becoming more familiar to the American people.

It has been said often that fish is the poor man's food, for, unlike any other food product, it may be had for the taking. A fish swimming in the water costs no man labor. In the cold waters of the North there float a hundred barrels of whale oil; covering the ocean's surface off Labrador's rugged coast, dart millions of mackerel. Along the coast of Maine, with its hundreds of inviting inlets and estuaries, waiting the pleasure of the fishermen, float the Atlantic's great variety of food fishes known the world over for their exquisite delicacy and richness of flavor. Farther south lie bushels of oysters, and the Southern waters teem with savory and nutritious food fishes. The fresh water lakes abound in whitefish, pickerel, herrings and other valuable commercial fishes, many of them now the results of the fish culturist.

To the earnest fish culturist it is not always hard work. There are times when he enjoys the fruits of his labor. There are times when the fish culturist feels sad and disheartened because those members of the finny tribe, those who owe to him their existence, fight him. When they passed the fingerling age, the age that always arouses a long discussion, they seem to forget their best friends. In that clear and beautiful Michigan stream there darts a three-pound trout, planted there years ago by the Secretary of this Society, but alas! this unkind trout has brought many a drop of sensible perspiration to the placid features of Hon. Herschel Whitaker, and continues to fan himself as the years roll on, without a sign of recognition.

Under that cluster of western lily leaves, resting after a gorge of a two-pound Missouri sucker, lies in perfect contentment a sixteen-pound Mississippi pike, who has broken many a rod in the hands of Hon. W. L. May.

In the shadows of Put-in-Bay's rocky shores, still playing at will, three and four-pound black bass, "the game fish of our country," glory in the defeat of one of their greatest admirers, in worrying Dr. James A. Henshall, bravely testing the rod of his design, but, alas! too, the good doctor was forced to leave his youthful habits, and now climbs the mountains of Montana, searching for a more gentle bass or for facts on how to catch trout in streams running up hill.

In that quiet stream known for its pious muskalonge, at Chagrin Falls, Ohio, are still three forty-pound monsters of his own raising, who year after year delight in breaking the most complete angler's outfit known to Eastern trade, and seem to laugh at the great fish culturist, J. J. Stranahan, who, in Spanish humility, has retired to the historic waters of Perry's victory for inspiration through the microscope.

Along the meadow streams, whose sparkle and brightness take their source from the hemlock shade, hang verdant branches, extending over pools of speckled beauties, every one known by name, who lay in wait for a graceful drop, but, alas! a fish culturist is seldom a successful fly-caster, and the branches and limbs contain a book of the choicest flies, left there by F. N. Clark, while the trout, propagated by his own skill, know him not.

The push and energy of our American railroad passenger men, in seeking the best fishing lakes and most romantic streams for lovers of the art of angling, has been the means of opening the eyes of our Wisconsin fish culturists, and the Hon. James Nevin, who has just begun to learn how to use, successfully, a Henshall rod, leads the people in seeing that the lakes and streams are over-stocked with fish to satisfy the angler's desire to test their fighting qualities in those deep, cold, clear streams.

On account of Toledo, Ohio, being so closely connected with the good people of Michigan, and that city having more truthful, expert anglers than in all the Western States combined, Seymour Bower finds it necessary to ask his legislator friends to pass a law to "license anglers." He had his eye on Toledo when the suggestion came to him.

Annually the sluggish Missouri overflows its sandy banks and rushes over the bottom lands, changing its current every five minutes; but when it retires within its banks, great pools of water remain, to be cleared, in time, and filled with all kinds of fish inhabiting this muddy stream. Often thousands of black bass are held within its sandy enclosures, and naturally become easy prey to the Nebraska angler. Under the shadows of bottom sycamores, W. H. O'Brien, Omaha's favorite son, annually seeks a favorite casting spot, and on account of reasons better known to himself and his fair companions, he has yet failed to land a single bass. Broken rods line the banks; tangled lines are in the branches of the trees. As a remedy, Mr. O'Brien proposes to "propagate a bass that will bite at worms and hook themselves," as illustrated in his paper before this Society to-day.

To the fish culturist belongs the honor of adding to the natural and artificial lakes and streams of the East the many species of trout from the Western waters, adding beauty and profit and pleasure to man. It remains for the fish culturist to suggest, and follow the suggestion by active work, the necessary remedies for increasing our fish food supply. The Government looks to educated, experienced men to handle successfully our navy. It must look to the educated, experienced fish culturist to solve the problems of how to increase our fish supply. The statute books of our States are crowded with laws which no one understands, least of all the men who made them, and which for obvious reasons, the Fish Commissioners, are powerless to enforce.

In 1903 the patriotic and public-spirited people of the great State of Ohio will appropriately celebrate the centennial anniversary of the admission of that State into the American Union. It is their purpose to make an exposition of the wonderful development of Ohio in financial, industrial, commercial and social lines. Taking time by the forelock, which is the habit we have in Ohio, the General Assembly, at its last session, enacted such legislation as seemed necessary to carry out the expressed will of the people that Ohio's centennial anniversary be duly commemorated. In their wisdom, the members of the General Assembly selected the rapidly-growing city of Toledo as the most desirable site for such an exposition as might naturally be expected from such a State as Ohio. Ohio was carved out of the old Northwest Territory, and Toledo, resting on a magnificent harbor a few miles from the extreme southwestern end of Lake Erie, is the most central point, geographically, of that territory. We have, too, easy access to all parts of the country by way of our splendid network of railways. On this occasion it should not seem strange if I obey the natural and ungovernable instincts of the true fisherman and extend to this Society, the individual members, and all fish culturists and friends here assembled, a most cordial invitation to prepare themselves for a display worthy of our Association. And on behalf of the hospitable people of Ohio let me include in this invitation the good people of the entire great West, whom we would be, indeed, delighted to have with us. In the light of the past deeds of our

State we feel safe in saying that Ohio doeth all things well, and that this exposition, at Toledo, in 1903, will be an Ohio exposition in every sense of the word.

Mr. Clark: I think that we had better take a recess at this time, as it will crowd us considerably to attempt to close our business this afternoon. There is one paper especially that I am very much interested in that is yet to be read, Dr. Henshall's paper.

On motion, the Society took a recess to 2 o'clock p. m.

AFTERNOON SESSION.

Two p. m.—The meeting was called to order by President May, and Professor Birge read a paper entitled:

THE RELATION BETWEEN THE AREAS OF INLAND LAKES AND THE TEMPERATURE OF THE WATER.

Mr. President and Gentlemen: I am going to speak this afternoon on the subject of the temperature of the small inland lakes, especially as affected by the area of the lake. For the last two or three years I have been working on the biological condition of the inland lake, taking up one point at a time, as my leisure from the University work will allow me to do it; for the past season I have been working on the temperature. The main work I have been doing is on my own lake Mendota, immediately adjoining our University. During the last open season I had temperatures taken of the water at all depths, twice a day during the season, and during the present season from the first of May on, I have been continuing the taking of the temperatures in that same fashion, and I expect to continue the work to the end of the season, hoping thus to get a tolerably complete idea of the changes of the temperature of the lake. In connection with this work I have been carrying on, especially this season, observations of some of the smaller lakes, at Oconomowoc, about sixty miles from Madison. The special point of these observations has been to see what the effect of the area of the lake would be on the depth to which the heat of the sun penetrates into the water.

The temperature of the water is one of the most important biological conditions in an inland lake. The temperature of the surface starts in spring from 32 degrees, and rises in summer to the very considerable height of 70 or 80 degrees, and falls again at the close of the warm season to the freezing point. This great gain of heat during the summer is caused, of course, by the action of the sun. The questions I have been trying to determine are these: How far does the heat of the sun penetrate into the water, and how does it get down to the depth which it actually reaches?

The heat of the sun falls on the surface of the lake, and there are three ways in which the heat may penetrate through the surface to the deeper water. In the first place, it may go down by conduction; the warm water warming by conduction the stratum immediately below it. This method is practically of no importance. The power of the water to conduct heat downward is so small that it may be entirely neglected.

The second way in which the heat may get down is by the direct action of the sun shining down into the water, penetrating it and warming it as it goes. This method means a good deal more than conduction, although it means a great deal less than is ordinarily supposed. By far the greater part of the heat of the sun is stopped by the first layers of the water and gets no further. All the heat that belongs to the dark portion of the sun's rays is stopped by a very thin layer of water, and that part which is in the luminous portion of the spectrum is very rapidly absorbed, especially if there are plants or other opaque particles in the water. If, then, the temperature of the water depended on the penetration of the sun's rays, and if the water were entirely undisturbed by the wind, we should find a high temperature only to a very small distance from the surface, and then we should find a very rapid change to cold water below.

But as a matter of fact, our lakes are exposed to the action of the wind, and this action constitutes the most important means of distributing the heat of the sun to the layers of water below the surface. The action of the wind sets up currents in the water, which distribute to a greater or less depth the heat which the surface secures from the sun. As a matter of fact, we find in the middle of summer a layer of water, often 20 or 30 feet in thickness, which has been almost uniformly warmed by the sun. The thickness of this layer depends not on the depth to which the sun's rays penetrate the water, but on the action of the wind distributing to a greater or less depth the surface layers which have absorbed the heat of the sun.

It follows from this method of distribution that the depth to which the water is warmed will depend upon the action of the wind, and if lakes in the same region are compared, which are equally exposed to the influence of the sun and wind, the amount of warm water on the surface and the depth which the heat of the sun will reach will depend very largely upon the area of the lake; or, in other words, if you compare lakes in the same region and of approximately the same depth, you will find that the temperature at any given depth will be less as the area of the lake is smaller. In order to illustrate this point, I have brought in a diagram on which I have platted the temperature curves of four lakes. The largest of these is Lake Mendota, 6 miles long, by 3½ miles wide, and about 85 feet deep. The second is Okauchee Lake, about 2 miles by 1½, and 95 feet deep. The third is Mouse Lake, about 1 mile by 1-3 of a mile, and 60 feet deep. And the fourth, Garvin Lake, is about 1-4 of a mile long and half as wide, and about 40 feet deep.

The temperature of these four lakes was taken on the same day, on the afternoon of the 12th of July, 1898. If you look at the curves you will see in the first place that the lakes have substantially the same surface temperature. They are all within about one degree of each other at the surface.

Secretary Whitaker: All taken at the same hour?

Prof. Birge: No; because one has to go from one lake to the other.

In the accompanying diagram each vertical space represents 10 feet in depth of water, and each horizontal space represents 5 degrees Fahrenheit of temperature. The temperature of the water in each lake was taken at every meter of depth, the result platted in the diagram in its appropriate place, and the points so marked connected for each lake by a line. Several things appear plainly from the diagram. In the first place, the layer of warm water at the top of the lake is thinner in the case of the smaller lake. In Garvin Lake this layer is about 13 feet thick, while in Mendota, the largest lake, it is nearly 30 feet in thickness, and in the two lakes of intermediate size it is of an intermediate thickness. This shows, of course, the depth to which the wind has thoroughly distributed the warmer surface water of the summer.

A second fact which is very plain is that at equal depths these lakes have a very different temperature. At 30 feet, for example, Garvin Lake has a temperature but little above 45 degrees, while Mouse and Okauchee Lakes have temperatures about 10 degrees higher, and Mendota has been warmed at this depth to a temperature of more than 67 degrees. Similar relations appear at all depths below 10 feet; the larger lake in every case having a higher temperature at any given depth than the smaller lake. A third fact appears with equal clearness, namely, that the temperature at the bottom of these four lakes is very unequal. In Garvin

Lake, the smallest, the temperature at 37 feet is as low as in Mouse Lake at a depth of 60 feet, and in Okauchee at a depth of more than 90 feet. All three of the smaller lakes have a bottom temperature 5 or 6 degrees lower than that of Mendota at a depth of nearly 80 feet. This feature of the temperature also depends on the action of the wind. The water at the bottom of a lake acquires most of its warmth between the middle of April and the middle of May, and the amount to which the bottom water would be warmed is largely dependent on the action of the wind during that month. It follows, of course, that the larger lake will acquire more warmth than the smaller lake. As the season advances the gain of heat at the surface is so rapid that the surface water becomes warm to such an extent that the wind is unable to distribute it through the deeper water. This condition is reached earlier in the smaller lake, and the time during which the bottom water can gain heat is consequently shorter, and the effect of the wind is smaller during this time. The bottom temperature is therefore lower.

You see, therefore, that the water in lakes of different sizes may possess a very different temperature at the same depth, and that the bottom temperature of a small lake is likely to be lower than one would expect from its depth only, and that of a large lake is likely to be higher than its depth alone would indicate. In Garvin Lake, indeed, at a depth of less than 40 feet, the bottom temperature is about as low as in Lake Geneva at a depth of nearly 150 feet, or in Green Lake at a depth of nearly 200 feet. This is because Green Lake and Geneva Lake are seven or eight miles in length, and are therefore exposed to a much greater action of the wind.

I don't know that I ought to say that these considerations have any immediate practical bearing on fish culture, but I think that any one must see that the small lake, with its shallow water and cold bottom temperature, must form a different kind of home for the fish from that afforded by a lake of equal depth but different area, and consequently different temperature.

Mr. Whitaker: How about the shallower lakes? Is the source of supply the same as that of the others? Are they spring fed?

Prof. Birge: Yes, I believe they are spring fed; the temperature of the spring water is very close to 50 degrees, so that the temperature here at the bottom of this lake is now four or five degrees cooler than the temperature of the spring water. There

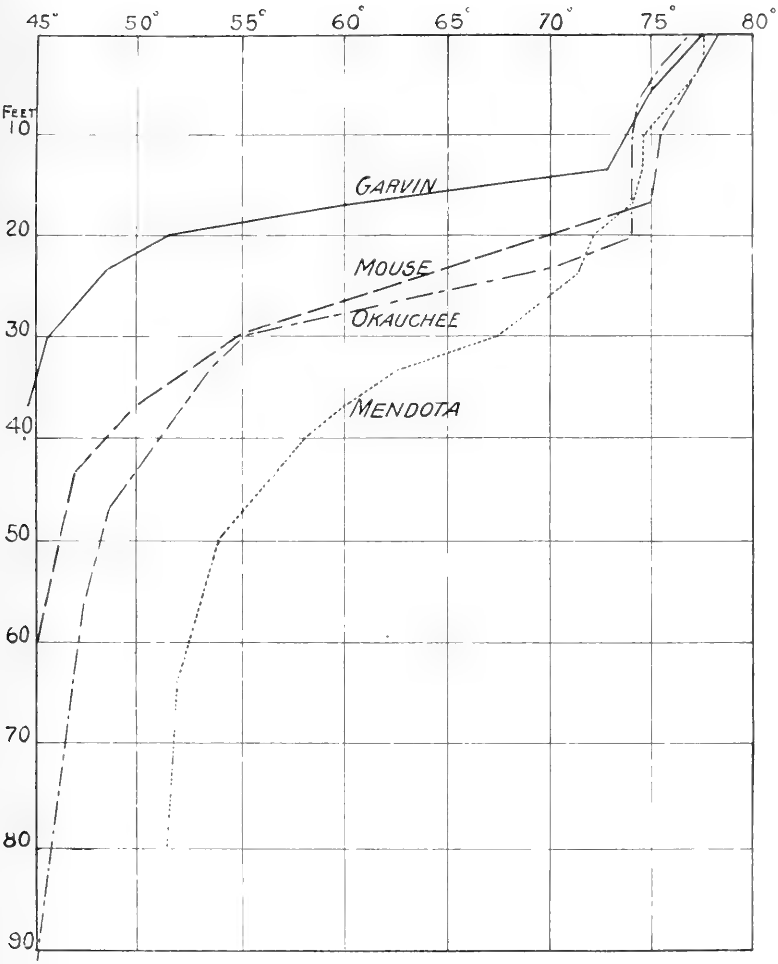


DIAGRAM TO ILLUSTRATE THE EFFECT OF AREA ON THE TEMPERATURE OF LAKES.

(Observations, July 12th, 1898.)

is a spring which I have tested about a mile from Garvin Lake whose temperature is about 50 degrees.

Mr. Whitaker: Have you ever made any observations with reference to the abundance of plants at the bottom of the lake?

Prof. Birge: No; I have not had time to take that up.

Mr. Whitaker: Do you know at what depth in these lakes the growth of plants stops practically?

Prof. Birge: It wouldn't get down to that cold lower water, anyway. You don't get a great many springs in the bottom of a lake. As a matter of fact, the spring would be more likely to come out near the level of the lake than further down. The spring comes from the head of water that is in the soil. When you get down below the level of the soil water there is less head of water. So the spring will ordinarily work out of the edge of the lake or in shallower water.

Mr. Whitaker: I believe the investigation of Lake St Clair showed that the bottom of the lake was covered with a perfect mat of chara. As I understand it, on all lakes there is a certain shore zone, bare of plants; made barren by the action of the waves, which prevents the growth of plants.

Prof. Birge: Not in these very small lakes. In Mendota, except at sheltered places, the wind affects the plants to a depth of 3½ to 4 feet.

Mr. Peabody: What is the greatest depth that the action of the wind reaches so as to modify the temperature?

Prof. Birge: So far as I know, its action extends to the greatest depths of our inland lakes. Green Lake is 237 feet in depth. The temperature of the water at the bottom rises during the spring and falls during the late autumn. I cannot conceive that this change is due to anything but the action of the winds.

Mr. Bower: I think your statement explains why some of the Great Lakes are more prolific as to production of fish than others. I understand that the greater amount of water life, the greater vegetation, the greater amount of fundamental life, the larger the higher forms of life. Of our Great Lakes there is no lake that begins to compare with Lake Erie in the amount of fish caught. There are large areas that are sheltered, but still subject to the action of the wind all the year, in a degree; that accounts for the reason why the most productive places are the bays; take all the bays on the Canada shore, and Saginaw and Green Bay, and they are by far the most productive areas. We get more fish in those parts of the lake than all the rest of the lake; don't you think that temperature in a great measure accounts for it?

Prof. Birge: I have no doubt that this has influence; but I don't really feel that I know anything about the problems the Great Lakes offer in regard to temperature. The shallow nature of Lake Erie must permit the sun to warm it up; you get the whole heat of the sun concentrated on the shallow water. While the heat is projected to a slight depth only in Lake Michigan, it produces a great deal of warmth in Lake Erie.

Mr. Bower: Take the whole of Lake Erie west of a point drawn across the lake from the east part of Sandusky Bay and there is not a spot anywhere that exceeds 46 feet in depth. There is a vast area there of a great many square miles.

Prof. Birge: The temperature at the top and bottom would probably be about the same.

Mr. Bower: It would seem from your explanation that the lake would be stirred from top to bottom.

Mr. Gunckel: I don't think there is probably any question that in the upper end of Lake Erie, the locality Mr. Bower has spoken of, that in the fall it is stirred from the action of the waves and wind, from top to bottom. From the fact that in very heavy winds when the whitefish are on, they are driven off when these heavy winds occur, and it must be stirred from top to bottom.

Prof. Birge: I might say also, where you don't get the water roiled, the wind has a great deal of effect on temperature; take it in Lake Mendota, the wind does not stir the water up from the top. There are horizontal currents which are moving around, which must produce a great deal of effect on the temperature. You will see in the diagram little irregularities in the temperature, which were not to be accounted for by the warming of the water. At 12 o'clock the temperature would be up a degree, and at 3 o'clock it might be down, and at 6 o'clock it might be up. We found continuously little fluctuations in the temperature which could only be due to currents flowing more or less horizontally.

Mr. Bower: I remember when I was a boy and used to go in swimming, we used to suddenly plunge into water that was perceptibly colder; it would only be just for a few feet and it would be warmer again.

Prof. Birge: That experience you will get, ordinarily, in the early part of the season, but not later than the 1st of July.

Mr. Whitaker: I suggest if there is no more discussion on this paper that we read one more paper and take a recess until to-morrow morning at 9 o'clock.

Dr. J. A. Henshall's paper was then read, which follows:

SOME PRELIMINARY OBSERVATIONS CONCERNING THE ARTIFICIAL CULTURE OF THE GRAYLING.

The grayling of Montana exists only in the tributaries of the Missouri River, above the falls, but principally in the three forks of that river, the Jefferson, Madison and Gallatin Rivers, and their tributaries.

In 1805 Lewis and Clark found the grayling near the headwaters of the Jefferson, and in the history of their wonderful expedition spoke of it as follows: "Toward evening we formed a drag of bushes, and in about two hours caught 528 good fish, most of them large trout. Among them we observed for the first time ten or twelve trout of a white or silvery color, except on the back and head, where they are of a bluish cast; in appearance and shape they resemble exactly the speckled trout, except that they are not so large, though the scales are much larger; the flavor is equally good."

This fish was not subsequently identified from this description, though any one acquainted with the locality and the fishes of the headwaters of the Jefferson could not doubt for a moment that the grayling was meant. Dr. Elliott Coues in his edition of the History of the Lewis and Clark Expedition, thinks the description applies to the blue-backed salmon (O. nerka) of the Pacific coast, though he says this genus is not known to exist in Atlantic waters.

In a recent communication to "Forest and Stream" I have advised the adoption of the name Thymallus lewisi for the grayling, on the strength of Lewis' description, and to relegate to synonomy Cuvier's name of Thymallus ontariensis, based on a specimen, the locality of which is unknown, though it was wrongly attributed, as I believe, to Lake Ontario.

Seth Green and Fred Mather claim to have hatched the grayling artificially from eggs procured in Michigan in 1874. Seth Green has a brief notice in his "Fish Hatching and Fish Catching" of the hatching of about 100 eggs, but says nothing, except in a general way, of feeding and rearing the fry. I have an impression that Mr. Mather has reported his operations at greater length, but I do not remember just when and where his account was published.

The first real effort in this direction was inaugurated last spring by the United States Fish Commission at a sub-station connected with the Bozeman (Montana) Station, and situated on the inlet (Elk Creek) of Red Rock Lake, the headwaters of the Jefferson River. This auxiliary station was in charge of Mr. A. J. Sprague, who was detailed from the Leadville Station, and worked under my direction.

Mr. Sprague took some 3,000,000 grayling eggs, 1,000,000 of which were hatched and planted in Elk Creek. Fifty thousand eyed eggs were shipped to the Manchester (Iowa) Station, 50,000 to the Leadville (Colorado) Station, and 10,000 to the United States Fish Commission Exhibit at the Omaha Exposition, all of which, by extra precautions in packing, arrived at their destination in good condition. About 1,500,000 were shipped to the Bozeman Station, but many were lost, owing to a lack of ice for packing the eyed eggs. Some green eggs were shipped as an experiment, and though seemingly in good condition on arrival at Bozeman, they all died soon afterward.

These eggs were shipped over a wagon road some sixty miles in a common farm wagon, without springs, and called by courtesy "a stage," from Red Rock to Monida, Montana, thence by railroad. The drive of sixty miles is made in one day, by relays of horses, and as the drivers are required to "make time," the eggs were subjected to much jolting.

The problem of transportation of eyed grayling eggs, however, has been satisfactorily determined. As the period of incubation is so short, it is absolutely necessary that the temperature be kept between 40 degrees and 50 degrees, say at 45 degrees. This can be accomplished by packing ice and dry moss beneath, around and on top of the stack of trays in the egg-case. A good plan, also, is to place an extra ice-hopper, in an inverted position, over the usual hopper; this answers the double purpose of keeping the moss dryer, and also allows more ice to be used on top. It is of the utmost importance that the eggs should not be subjected to the least pressure during transportation. There should be very little, if any, moss placed over the eggs or between the egg-trays. Any pressure on the eggs causes fungus to develop, and is fatal to the life of the embryo.

About 500,000 eggs were hatched at the Bozeman Station, and at least 50 per cent. of the fry are alive, and most of them are feeding.

In stripping the female grayling, the eggs are a little harder to start, but are then extruded more freely than in the case of the trout. About 3,000 eggs is the average for a fish of twelve inches in length. The eggs are white and as clear as a crystal; they are smaller than the native trout (S. mykiss) eggs, but after impregnation and the absorption of water will average one-seventh of an inch in diameter, while the native trout eggs are one-sixth of an inch, and the brook trout (S. fontinalis) eggs are one-fifth of an inch in diameter.

Soon after fertilization the eggs become glutinous and adhesive, forming bunches or masses of various sizes, when fungus rapidly develops and kills the egg. This renders the work of picking laborious but imperative. The embryo develops rapidly, and is in constant motion, often causing the egg to roll over on the tray. The grayling eggs are lighter than trout eggs, almost semi-buoyant, and from our experience would be better hatched under a pressure of water from below. In an improvised jar they did well, and the bunching and development of fungus did not occur. Perhaps the method followed with pike-perch eggs in using starch or muck might cause the eggs to separate, and the bunching be prevented. Next season I propose to experiment with fine quick-sand, so-called, which is abundant about Red Rock Lake; it is more like fine marl, as fine as wheat flour.

The embryo begins to show life and motion before the eye-spots are visible. The eye-spots are small gilt specks, with a minute black pupil, and appear in from three to five days. The period of incubation is from 10 to 12 days, at a temperature of about 50 degrees. The fry are hatched with a very small yolk-sac, about half the size of the egg, and which is absorbed in about a week, when the fry immediately becomes a free-swimming animal, about one-half an inch in length, and is quite slender and delicate. They do not begin to feed so readily as trout, and require constant coaxing, as often as every half hour, with liver as finely divided as possible, being in fact bloody water. The best method of feeding and rearing is yet to be determined. Those hatched and planted in Elk Creek did well, being double the size, at the same age, of those hatched at Bozeman Station, which proves that we must follow, as closely as possible, the natural conditions of breeding.

The grayling does best in sandy and gravelly streams, with swift and pure water. It is a much superior fish for the table than any of the trouts, and in game qualities is their equal. As the species is rapidly disappearing, it seems to be important that so good and beautiful a fish should be preserved by artificial propagation, and no reasonable efforts should be spared to determine the conditions best suited to its successful culture.

Mr. Clark: This work of Dr. Henshell is a matter that I am very much interested in. In the year 1885 the United States Fish Commission gave me instructions to proceed to the Au Sable River to investigate the spawning of the grayling, and I will say, by the way, that I kept a report of that trip, and meant to have it here. At that time Mr. Bower was my assistant. He was dispatched to the Au Sable and we succeeded in obtaining a few grayling eggs. I think there were 25,000 taken to Northville. Of that number, 5,000 were shipped to Washington, and from there sent to Wytheville, Virginia. There was no difficulty in shipping them. The experience we had in hatching them was something different from the Doctor's. We had no trouble about the eggs sticking any more than with trout eggs, and they didn't bunch up after we had them on the trays. They of course adhered slightly, but after you had separated them there was no bunching. We had no difficulty in hatching them; the difficulty with us was in raising them after they were hatched. The time we used in hatching in a temperature of probably 55 degrees was from fourteen to twenty days. At the time Dr. Henshall was about to commence the work I received a letter from my chief, Mr. Ravenel, in Washington, in reference to the Doctor's taking hold of that work, and he asked me what I would suggest as an apparatus for hatching. I suggested the jar if they were to be handled in large quantities. I see the Doctor did try the jar. I don't know whether you gentlemen have seen the young grayling at the Exposition grounds, but when you do I think you will say they are different from the young grayling we hatched in 1883.

Mr. Bower: At the time we attempted to secure the grayling from the Au Sable and Manistee Rivers, those streams were literally filled with logs. Of course, the fish at that time of the year didn't bite freely, and the only way we could get them was by bottom fishing, using worms or minnows. The opportunities for fishing were limited to occasional open spaces in front of where logs had lodged. We succeeded in getting between 40 and 50 adult grayling, none of which were ripe. We held them in crates a few days, until ripe, and in this way secured about 50,000 eggs.

They were quite different from Dr. Henshell's in color. He speaks of their being white. Ours were not white, but translucent; in fact, they looked about like the Lake Superior whitefish eggs. On two points there seems to be a radical difference. One is that our eggs were non-adhesive, and the other is that they were not white.

Mr. Clark: I would like to state further that Mr. Bower sent down to Northville a certain number of adult grayling, and among them I found a ripe one the same day they arrived. We took the eggs from that fish and they amounted in number to a little over 5,000.

Mr. Peabody: Your experience in Michigan is that it is not profitable to raise them? Have you succeeded in doing it to any extent?

Mr. Clark: We have not succeeded well with them.

Mr. Whitaker: I haven't any doubt in my own mind that there are marked differences in the habits as well as the character of grayling in localities remote from each other. The European grayling and the American grayling differ, and very likely there are differences between the grayling of Montana and the grayling of Michigan.

The streams lying in the upper half of the lower peninsula of Michigan originally contained nothing but grayling and the fish were so plentiful that a lady living at Reed City told Dr. Parker, a former member of our Board, that she had seen farmers come there at the time of grayling spawning, and from under the apron of the dam, with an ordinary pitch-fork, fill a small wagon-box with grayling. The grayling, however, have practically disappeared from nearly all our streams. I have come to the conclusion from my experience that their decadence is chiefly owing to the fact that the spawning season, coming as it does, just before the breaking up of the ice in the rivers, filled as they are with logs, it follows that the logs plow up the beds and destroy the eggs, and that log-running is responsible for the disappearance of these fish from our streams. I introduced a resolution in the Michigan Board of Fish Commissioners at one of its meetings in 1878 to stop the further planting of brook trout in grayling streams and their tributaries. I urged that it was not policy to cease trying to propagate the grayling, and that we should make some experiments looking to the planting of the grayling in waters in which they were indigenous. We passed the resolution and such steps were taken. We subsequently organized an expedition, quite a number of spawning grayling were obtained, and the fish were held in a preserve where they might spawn naturally. I never was entirely satisfied with the care exercised over those fish in that experiment, but as a matter of fact, it resulted in nothing. We tried it two or three years, but it failed. Seth Green once said to me: "Whitaker, you will never be able to raise the grayling; he is an Indian, and won't stand domestication." And it seems as though he was right.

I don't coincide with the professor's ideas as to their edible qualities. I do not think they can be compared with the brook trout. For fighting qualities they rank well; for the novice fly fisherman they are the fish par excellence, because any greenhorn can get him. Dr. Parker once told me that on a branch of the Manistee River he noticed a little grayling rising to natural food on the surface, and he counted that he rose twenty-seven times.

It seems to me after the experience we have had, that it is a loss of time to try to do anything with the grayling. He isn't worth the trouble. The brook trout is a superior fish in every respect, and responds so kindly and readily to the methods of propagation that it is hardly worth while to do anything with the artificial culture of the grayling. I hope Dr. Henshall will succeed. He is a careful man, a painstaking man, and it is quite possible in that country where the streams are not subjected to log running he may succeed. I think it may be possible that this massing of eggs he speaks of is due to the injury they received in the sixty miles of haul.

Mr. Clark: As a partial answer to Mr. Peabody's question of why we abandoned the work, I should say, as Mr. Whitaker has said, that they are not easily domesticated. At Northville we proved, beyond a doubt, that you cannot do anything with the grayling in confinement. You have the fish, but you simply cannot get any eggs from them. This was also the experience of Mr. Babbitt, of Michigan, who has also experimented with them. I sometimes feel it is too bad that the grayling in Michigan streams are going. I wish the Commissioners might have reserved one stream until log-running was finished. It might be well for the United States Commission to bring some of the Montana grayling and plant them in some of those streams, because they never can do any hurt; they never eat any trout; it cannot do the harm the brown trout of Germany do. I don't think it is practical to undertake to get grayling eggs in Michigan now.

Mr. Whitaker: It is possible we may always have a few grayling in Michigan.

Mr. Peabody: I would like to ask about the temperature required for grayling. Will they stand as warm water as the trout?

Mr. Clark: No; I don't think they do. The Au Sable River is 65 degrees when the air temperature in the shade is 98.

On motion a recess was taken until 9:30 a. m. of Friday, July 22d.

FRIDAY MORNING SESSION.

Friday, July 22d, 1898, 9:30 a. m.

The meeting was called to order by Vice-President Peabody.

Mr. Whitaker: We have three papers yet to be read. The first is by Dr. Bushrod W. James, of Philadelphia, entitled, "The Protection of the Pacific Coast as Related to Food Supply."

Mr. Whitaker then read Dr. James' paper, which follows:

PROTECTION OF THE FOOD FISH SUPPLY ON THE PACIFIC COAST AND IN ALASKA.

The great abundance of excellent fish in the northwestern waters, the revenue from which in years past has mounted into millions of dollars annually, would suggest to many persons that the consideration of systematized protection regarding them was entirely superfluous at this time. Yet a cursory glance at the history of the larger animals, whose habitat has been the Pacific Ocean, Bering Sea and the Arctic Ocean, will be irrefutable evidence that it is better to agitate the question before the lesser fish have been threatened with extinction. In the class of valuable fishes in Alaska the great mammals of the water have always been included, but of one of the most important, the seals, nothing can now be said, as their protection, having been submitted to arbitration, must depend upon the decision so secured; time alone being able to demonstrate its efficacy.

Whales, sea lions and walruses, however, remain without any safe-guard, and their annihilation has been imminent for several years. As food fish they have always been most valuable to the natives of the territory, as have been the same family of creatures to the inhabitants of Greenland, on the Atlantic coast. The neglect to provide some protection to the Atlantic whale is well known to be most disastrous, the whaling fleets having found themselves compelled to quit the business because of the scarcity of their prey, until now, it is stated by an influential journal, that if it were not for the occasional success of whaling in Alaska, the business would be completely degenerated. As it is, the falling-off has been so great that even the Pacific whalemen are turning their talents in another direction. The great value of this animal to merchants is well known, but now the reduction of the quantities of bone and oil has sent the prices upward phenomenally, putting them beyond the tradesmen, who find few consumers willing to pay the advance, rather accepting cheap substitutes instead.

But it is of them as the life support of Alaskan coast natives that I am inclined to speak at present. Until another mode of supplying food, clothing, shelter, boats and fishing implements, and even fuel, has been instituted for the extreme coast natives, they must have whales and walruses, or perish. It is the diminution in the number of these that has sent tribes of natives far from their usual resorts. It has been the seasons when only one or two of the great animals appeared that have made primitive settlements desolate and reduced the inhabitants to pitiless destitution. This state of affairs has not been sounded from one end of the world to the other, because the Alaskans are neither a warlike nor a complaining people.

For the sake of humanity, as well as for the very momentous item of wealth, there should be legislation limiting the catch of all other mammals as well as their acknowledged superior, the seal, until they have been permitted to increase, and after that there should still be a close guard against over-stepping a proper margin. It is not yet too late, but delay will certainly lead to the total destruction of a once most lucrative traffic in bone, oil and ivory, for the latter of which the immense walrus was hunted until his presence is seldom found in his former haunts.

The history of these fisheries will tell how all the civilized world sent large fleets for the capture of the animals, and how reports gave glowing accounts of their inexhaustible numbers.

But what were they in comparison with the millions of salmon than can literally be forked out of the water as fast as a man's arm can use an ordinary drag net? They are said to haunt some of the rivers during their run in such compact masses that the barefoot natives can walk over them and dip baskets down into the moving schools, removing hundreds, only to make room for thousands more. Speculation has pointed the way, and canneries have appeared with enormous capacity. It was so in Karluk River some years ago; now, the United States Treasury Department has officially stopped salmon fishing in Karluk, except that sufficient fish may be captured to supply the hatcheries along the river banks; and this is done to prevent threatened depletion. Yet it is stated that the Pacific coast fisheries will require about 80,000,000 cans for their year's catch, as they have used that number annually for several years. Many of the fish are taken in traps, and from 10,000 to 40,000 salmon are taken in one trap. It must be remembered that all this number cannot possibly be choice, and there is no doubt that thousands are wasted because of undersize or non-marketable quality. But to remedy this defect some companies have permitted them, and the different kinds of fish taken with them, to appear under the same label as the better article. Dealers have fortunately discovered this, and the only thing for the canners to do to redeem their reputation is to exclude all but the finer quality, as they did heretofore. Perhaps there has been some excuse for this in the falling-off of the Columbia River salmon, whose excellent qualities have created an enormous demand, and in filling standing orders the workmen may have in haste made mistakes in the canning. Or, more probably, inferior qualities have been carelessly handled among the better and received the sign manual that had belonged previously to none but the superior article. Possibly disaster has befallen some firms through this unprofessional handling. But the streams are still so well stocked with the fine grades of salmon that no one need suffer long who has the energy and the capital to start in anew, with thoroughly reliable stock.

The "Royal Chinook," whose magnificent proportions have often tipped the scales at eighty-five pounds, whose beautiful deep-pink flesh has charmed the epicure, is still abundant in the North-West, though a little caution in the catches will be necessary to keep up the supply. But he has a rival, so small as to seem at first hardly worth fearing; its name alone being anything but attractive. Yet, the little six to ten-pound "sock-eye" has certainly swam to the front. Its beautiful red, firm and richly-flavored flesh, and its preserving qualities, have nearly overshadowed its royal brother, as well as the Alaska salmon of the greater rivers. But here come announcements of new companies who will pack nothing but "sock-eye." Puget Sound fisheries, wherein the fish are caught on their way to Fraser River, are preparing to take greater numbers than they did before, for the reason that the exports call for the rare, new commodity. More canneries are to be erected at Astoria for Columbia River salmon, at Fairhaven for the Puget Sound fish. In Washington, new traps are to be put in place for the expected rush of the salmon. Companies are forming and locating for salmon fishing. Cold storage plants are being erected for the salmon catches in different parts of Alaska, Washington, Oregon and British Columbia. A Dane has patented an arrangement by which fish can be carried great distances while still alive, and the device is to be used in carrying salmon as far east as the fish will keep. The result of all this must be distinctly foreseen by any thinking person. One day, not far distant at this rate, salmon will be so scarce that the canneries will be forsaken and capital taken in another direction, whereas, if the Treasury Department or its representative Fish Commission, will place restraining measures upon this evident wholesale grasping, confining the seasons, prescribing the fishing until a number of the strong, finer fish have had time to reach the spawning grounds, and thus perpetuate their species; the salmon fisheries will not be exhausted as they must be soon, judging from the stupendous preparations that have been made for their extermination.

One manner of preserving them as well as other fish, is by allowing a fish-way in every dam, by prohibiting the erection of enormous traps and wheels that must soon depopulate the waters of all kinds of fish, unless it is expected that fish themselves will discriminate and keep out of the way; by insisting upon limited seasons, and by also requiring companies to avoid over-production of their commodities. It is not desirable to keep fish, particularly, from season to season. The fresh article is always in demand, but there is a certain modicum of danger in keeping them over. Having estimated the quantity required for a year's trade, it would be only diplomacy to stop at that, and let the fish have liberty to grow and multiply. Our Fish Commission is cognizant of this, and with Government to legislate there will be no danger of the salmon canning business becoming a failure.

It has been said of Americans that they are greedy for wealth, but the desire for revenue from fish has dominated every nation, and when our laws are prepared for the protection of salmon in Alaska and Puget Sound, we will evidently be required to gain the co-partnership of British Columbia, else some of the more valuable kinds will not be fully guarded.

Another great fishing scheme is being advanced rapidly of late, for the taking of sturgeon, Pacific sturgeon being found finer flavored, firmer in flesh and better for keeping than the Atlantic fish. Possibly, there is little wonder for this when we think of the pure, almost unknown waters in which the former live, and the uncleanly waterways in which many of the Atlantic sturgeon are caught. In Fraser River the sturgeon has been found of great size and richest flavor. One fish was taken that weighed over 900 pounds. This fish is to be shipped by cold storage; the roe will be sent to Russia for caviare making, and the Chinese prize the spinal cord after it is dried. There seems to be no idea of canning the sturgeon, though it has been whispered that the same has been found masquerading as salmon in some grades of canned goods. Sturgeon is sufficiently well known to be appreciated under its own name if it is properly handled. And here a word with regard to the matter of handling. I think the fisheries are endangered by the manner in which many fish are marketed. Perishable as they are, the housewife is cautions in purchasing unsightly fish, and the Commission should ask for local legislation that will dominate the sale of fish in every market. If this was established, more fish would be used and less left to waste offensively. Thus far there is unquestionably an over-production of all but a few choice varieties. With careful manipulation all fish would be more tempting, and if the purchaser did not see the fish that was wanted she would possibly take another not very inferior. To protect the fishing interest everywhere, the fish should be delicately handled to prevent unsightly appearance, and they should be fresh beyond all doubt.

To prove that a limitation of the catches of the different fisheries will permit the numbers to attain a certain annual average, we will find that the species that have thus far been allowed comparative freedom are found in amazing quantities in their haunts. Smelts and herring, perch and pompano, cod, halibut and mackeral, trout and many other varieties can actually be captured by the ton in virgin waters. We must look to it that none of them are so captured until the waters are suddenly depleted.

In this connection I wish to speak of carp, some of which grow to the size of fair specimens of sturgeon. I was one time criticised for stating that these carp destroy other and more valuable species, but to-day there comes the complaint that young fry are being devoured by carp. As this fish has proved itself less desirable than was expected, it would be an excellent idea to allow it to be taken in all ages and sizes, or else these ravages will materially injure the business of the hatcheries.

A comparatively new business is progressing finely in the northwest in planting and preparing oyster beds and the better quality of lobster has also been transplanted. Puget Sound oyster canneries have only been in full operation for three years, and in that time they have increased in value one hundred and fifty per cent. Here again the danger threatens that injuries every other part of the fishing business. It is, as soon as the product shows phenomenal success other companies rush in to claim a share, and thousands upon thousands of really almost unsaleable stock will be spoiled in the pursuit of the more desirable kind. Let the fisheries get a good start, then allow just a reasonable amount to be taken at once; in time, the supply will increase to meet the greater demand, and the northwestern oyster fisheries may be looked upon to make up in a measure the great falling off of the Atlantic product.

It was this falling off that led Seth Green to open his eyes to a stern necessity for replenishment, when, in 1864, he began experimenting in artificial propagation of food fish. The good that his work has done now extends from one state to another all over the breadth of our land. The fish commission has become an institution of the Government, and to it the Pacific as well as the Atlantic fishermen and dealers look for supplies of some of the most valuable denizens of river and ocean. Through the efforts of the commission salmon has been restored to the east and shad made known to the great west. From this we must be assured that their every effort should be appreciated and their millions of fishes protected from extermination. To do this plans must be legislated to prevent the vast numbers of the products of the waters to be met with yearly increasing arrangements for their destruction. Because an immense haul is expected, greater facilities are greedily and hurriedly completed, as if it were not wiser to permit this year's fish to insure as great results for next year.

But a short time ago we heard of the "sock-eye" salmon, next we hear of the millions that are taken and the great wealth that is being expended upon new fisheries for their capture. Oysters are becoming abundant, therefore, on rush the speculations regarding them, the calculations of their value this year by their lesser value last, until in very little time there will be more deserted canneries, more buildings to fall to decay, more men disappointed in employment, more speculators mourning over financial loss.

Another trouble appears at this present crisis, as the Atlantic fishermen have decided to join with those of the Pacific in cod, halibut and other fishing. The war is truly blameable to an extent for this, but, indeed, the Atlantic fisheries have been in a doubtful condition longer than the war can have been threatened, taking even the first grumble ten years ago. Unquestionably, the United States Fish Commission will find ample work on either side of the Union to provide a large enough supply for the dual demand. This cannot be done by propagation only, but by a judicious economy in the fishing permits granted to companies, or even individuals, as some are quite equal to carrying on a large independent business. Therefore, the commission should first extend the jurisdiction so as to embrace all the fisheries, even the sponge fisheries of Florida. But as I am particularly limited to the Pacific coast, I should say that no fishery should be entirely independent of the commission's careful supervision, even where the myriads of fish seem to promise inexhaustible supplies. It should guard all from depletion, and by so doing the profit will continue at a consistent ratio over decades, or we may say, centuries of prolific business, instead of being rushed through at lightning speed, with but a few individuals or corporations gathering the enormous profits, leaving so little that even the natives of the most distant points will suffer, if not perish, for want of their annual complement of nature's provisions for their maintenance.

A grand movement in the proper direction has begun in the establishment of schools for the study of the habits and culture of fish. In the pursuit of this subject, for instance, I find that the Fraser River salmon has a supply of oil in its composition which aids in the preservation of the flesh, and it suggests to my mind the utility of compressing the oil from the heads and tails, the discarded parts from the canneries, and using that oil for the preserving of these salmon and others of different kinds that require the addition of oil.

I would second the idea, also, of inventing some plan for using up the skins, heads, tails and other refuse, not only of sturgeon but of all fishes at the canneries. The prevention of the enormous quantities of offal being left to render the atmosphere pestilential would be no less desirable than that so much objectionable matter should not be returned to the sea in decomposing streams when rain fell in copious showers, thus providing literal poison for the living fish. And this kind of protection is extremely desirable, for even in the waters of Alaska fishes have been found with diseases or with parasitic enemies that cause sloughing. At first this latter trouble would seem like a sort of cankerous malady, but it is known that fish never renew their scales, nor do those that have no scales renew their skin to its normal condition after having been injured. If then, the parasite that renders one fish unsightly is freed from that fish and cast among others it is natural to suppose that the objectionable creatures will multiply upon the other fish with which they come in contact.

With limitations in the catches, even to the establishment of off seasons when necessary, I would earnestly suggest that the refuse matter from every cannery or drying and salting station should be turned into oil, glue, or possibly, dry compost. And if none of these commodities can be obtained from it, then let the useless offal be burned, either chemically or with fire. I should think that there could be cheap furnaces made of rocks and stones, and the fires once started could be kept up by the judicious distribution of the refuse. Would it not pay to consume or otherwise decompose the matter that will assuredly injure the very young and delicate food fishes, the flavor of which is their chief attraction to the consumers?

That California has its profitable fisheries, that Mexico has opened the Pacific coast of Lower California to the world of fishermen, that Alaska and British Columbia teem with millions of salmon and other fish does not say that there need be no more thought of economy or protection. A glance will show that both are now more absolutely requisite than ever, for the tide of the Atlantic will turn to the west in colonies of disappointed, heart-sick men who know nothing but how to take and cure the food productions of the sea. They will flock toward the fishing grounds as do the gold seekers to the new Eldorado. It will not do to wait until their migration happens. It would be ungenerous to let them go and then supply laws of which they know nothing. Instead, let the commission carefully prepare schedules of the regulations that they know to be required for the protection of the fishes, and through that for the longevity of the fisheries, and follow this by presenting them to the proper authorities for inspection, consideration and legislation. Follow the matter so that it must be put through quickly. Include every kind of fishery in this—that is, the oyster and sponge and pearl, as well as well-known fish from whale, seal and walrus, down to the tiny, delicious smelt. If this is done now while these fisheries are in comparative infancy, there will be no danger of extermination, no cry from men who have lost their legitimate business through ignorance or carelessness.

There is, and will be, increased demand for canned fish, as they are now included among the stores for army and navy, but there is great fear of over-production, particularly if the war is soon ended. Then it becomes again necessary to warn, not only against over-supply, but also against using any but the best manner of preserving fish, so that no one can be injured when the goods are cheapened and sold to the people.

As food, fresh fish well preserved and carefully canned, is desirable both for health and variety of menu. But diseased, decomposed or chemically tainted fish is not only an abomination but an active poison.

When preparing the new fishing laws, this phase of protectioshould be most elaborately introduced, for the selfish reason that people will not buy any goods of the kind if the reputed harm they do is accepted as fact, as well as for the humanitarian reason that it is unjust to permit inferior commodities to get in the market.

When all things have been done to prevent over-supply, overfishing even in teeming streams, and improper preserving—when the rivers are protected from poisonous matter, and all the parts of the production are utilized, then may the commission promise, through these protective laws, and increasing numbers of artificially hatched fish, to make the fisheries of the Pacific States and Alaska as nearly inexhaustible as it is possible for such to become.

I know that there has been squabbling and dissatisfaction between Washington and Oregon, between Alaska and British Columbia, and this proves that both States and countries must conjoin, nationally and internationally to protect their fish, and then to amicably share their profits in the animals which make both States and nations equal as they pursue the beautiful tenor of their lives among the intersecting waters that make all States and countries their own.

Mr. Whitaker: The next paper is one prepared by Hon. John W. Titcomb, commissioner of fisheries and game of Vermont:

DESISABILITY OF STATE ORGANIZATION FOR THE PROMOTION OF FISH CULTURE AND FOR THE PROCUREMENT OF STATE LEGISLATION FOR THE PROPAGATION AND PROTECTION OF FOOD AND GAME FISHES.

The objects of the American Fisheries Society obviously cover the title of this paper to the extent that it might be more plain to the members if it read: Desirability of State Organizations for Promoting the Objects of the American Fisheries Society.

Nature liberally provided the waters of the world with food for man and has been lavish in allowances for waste both from natural and artificial causes and the improvidence of man. With the progress of civilization, the increase of population and the change in natural conditions caused thereby with the consequent increased demand for fish food, the lavishness of nature is set at naught. It will be conceded that the fish in the waters are intended for the use of man. Their protection then is simply a safeguard to prevent the supply from being exhausted and to make the production, whether artificial or natural, as useful to man as possible.

It will be conceded by all members of this society that the artificial propagation of fishes has passed beyond the experimental stages and that it is political economy for States to engage in fish culture. It will also be conceded that nearly all fish must be protected at certain seasons if they are expected to reproduce their kind and nature is to assist in the work of the hatcheries. How many of our State legislatures are convinced as to the desirability of propagating and protecting fish to the extent that wise laws prevail which are not subject to radical changes or repeal at each recurring legislative session? Nearly, if not all, the States have some kind of protective laws, some wisely drafted and more that have no reason for existence. Protective laws, so-called, often defeat the very object for which they are enactd. It is a common custom for legislators who want more liberal laws, which, for example, provide for the use of nets in waters where nets should be excluded, to draft a bill reading somewhat as follows: An act for the protection of fish in Lake .... and then follows a bill providing for the extermination of fish in said lake.

In listening to many valuable papers read during the National Fisheries Congress at Tampa last January, of interest to both sportsmen and commercial fishermen; I was impressed by the fact that almost every paper, scientific or otherwise, alluded to the question of legislation and the condition of public sentiment. If the paper did not allude to legislation, the discussion which followed its reading would do so. Examine the laws of any State and many will be found which are practically void. I do not refer to fish laws in particular, although this class of legislation will be found in the above category quite as frequently as any other. Two reasons will be found for the lack of observance of void legislation. First, the laws may not be wise ones and have no good reason for existing. Second, public sentiment is opposed to the laws either because they are unwise or because the people are ignorant of the real reasons for their enactment. This public sentiment may or may not extend throughout the State and it may be limited to one town or one county in the State. If public sentiment throughout the State is opposed to the observance of a law, its enforcement is practically void. If one townor county is opposed to the law, it is for purely local selfish and short-sighted motives, but it tends to make the law ineffective if its enforcement is left to local officers. It frequently occurs that the small section of a State in which the law is unpopular can send a strong enough representation to the leislature to obtain its repeal against the best interests of the State at large. All such work injures or weakens the efficiency and popularity of protective laws in general. The average legislator becomes disgusted with the frequent introduction of bills for the propagation and protection of fish and pays little attention to them unless such bills are called to his attention as directly affecting the interests of his constituents. He often goes to the capital with certain objects in view and interests himself in executing those objects by the passage of certain bills regardless of other interests. I do not intimate that he is dishonest, but his energy is exerted in the interests of his own constituents. He has not time to investigate proposed legislation on the fisheries, for instance.

If then, the legislature does not believe in the propagation and protection of fish, an organized effort must be made to educate legislators as to the value of such work. The political economy of such legislation must be demonstrated and an appeal made to their pockets. This work should begin by educating the entire people of the State. The education of the people and the shaping of good legislation go hand in hand. The representative of a community is usually chosen because he has been successful in the management of private interests. If he sees that his constituents are interested in certain legislation, he will interest himself sufficiently to act intelligently upon it. I have attempted to show the necessity of organization to promote the objects of this society. I will now describe an organization which has been doing successful work for nearly eight years. It has been said that fish and game protective societies seldom live more than two or three years. Such is too often true, but if they are managed upon a strictly business basis, their period of usefulness will continue as long as the objects and aims need fostering.

At the risk of appearing egotistical because I was one of its promoters, I will describe the Vermont Fish and Game League, how it was organized and what it has accomplished. While its work is confined to a State with commercial interests of comparatively small importance, the same kind of an organization can be effected suited to the needs in other States. Some States already have similar organizations.

Methods of Organization: The first steps taken were as follows: A circular letter was sent to every postmaster in the State asking him to name all the citizens in his town who would be interested in a State organization for the protection of fish and game. A reply card was inserted. An alphabetical index of all names received in reply to this circular was booked and a second circular was sent to all whose names were thus booked, inviting them to pledge themselves to join a proposed league with the above named objects, to agree to pay a certain fee (in this case $5) when one hundred names had thus been pledged and with the understanding that no articles of incorporation would be procured or organization effected until the one hundred names were pledged. The same circular requested each recipient to send in names of eligible members. Frequently the same names were sent in by several sportsmen in one community, showing the desirability of keeping an alphabetical index of all eligibles to avoid repetition in sending out circulars and to have as complete a record of eligibles throughout the State as possible. In response to the second circular, 111 names were pledged and articles of incorporation immediately procured and organization effected. A meeting of charter members was called, a constitution and by-laws (previously prepared) was adopted and officers elected. Of the 111 charter members, all but one redeemed his pledge by paying into the treasury $5. From the date of organization in 1890 to the present time, the membership has constantly increased, until the present membership is 563. After the first year, the membership fee was reduced from $5 to $3 and the annual dues from $3 to $2. Town and county protective associations were admitted as branch clubs and permitted to send one delegate as a voter in all business meetings. Regular meetings are held annually and special meetings from once to twice per year. At the annual meeting a dinner is given after the business is transacted, followed by post-prandial exercises. The past three years a so-called mid-summer meeting has been held on an island in Lake Champlain. At these meetings many notable men are gathered. On the occasion of the last meeting President McKinley was present as a guest. Politics are not allowed to enter into the work of the league or to be discussed in the meetings nor enter into the post-prandial exercises.

The subjects in which the league are interested are kept constantly before the people by means of cloth posters giving a synopsis of the laws, pamphlets containing the chapter of game laws in full, by frequent circular letters to the members scattered throughout the State and by the voluntary aid of all the newspapers published in the State.

The people must know the reasons for the fish and game laws and that they are not designed for the especial benefit of the fishermen, but for all the people. There should be no protective law—no close season on fish and game without a good reason for it. When the people are convinced that as a matter of political economy fish and game must be protected, they should understand that the laws are framed with especial reference to the habits of each species thus protected. Take, by way of illustration, the statutory limit on fish which can be legally caught—the six-inch law on trout, for example. All the people should know that trout will not reproduce in our streams until they have arrived at an age when they will have attained a growth of six inches or more. They would then understand that if allowed to be caught before they are six inches long, reproduction ceases and with the excessive fishing now prevalent, all trout will be killed before arriving at the age of reproduction and total extermination follows. Artificial propagation and stocking cannot replenish the waste. The same rule applies to the statutory limit on salmon, lobsters, etc. The statutory limit for each species to be legally caught should be one which will permit natural reproduction at least once before capture or there is little argument for the law.

When the league was organized eight years ago, public sentiment was at a low ebb so far as fish and game interests were concerned. With its inception, an appropriation for a State hatchery was secured and liberal appropriations for its maintenance and extension have followed. Through the interest awakened by the league, a national hatchery was located in Vermont. The game laws, which were in a wretched condition, were codified and revised by a committee from members of the league, presented to the legislature in the form of a bill which at the same time repealed all existing legislation of the same nature and became a law almost without a dissenting vote. Our legislators are beginning to consider it a matter of political economy that these interests should be fostered and the league loses no opportunity to present to the public and to the skeptic the arguments which will appeal to their pockets.

I would not have you think that our laws are perfect or that what has been accomplished was attained without hard work on the part of the administrative force of the league. We have asked of our legislature what we thought we could obtain. As public sentiment increases, more desirable legislation will be asked for.

The poacher, like the poor, is always with us. He is only kept in check by rigid enforcement of the law whenever opportunity offers. When necessary, we do not hesitate to send to the city for a good detective and pay the costs out of the league treasury. In Vermont the league is the strong right arm of the Fish and Game Commission.

If any one is lead by the arguments in this paper to organize a similar society, let him consider well two important features. The work connected with its promotion and future success is tremendous. No salaried officers exist, although in a State of such important fishery interests as, for example, Florida or Louisiana, there should be enough of a support to pay the salary of a stenographer.

Work of this nature once successfully undertaken by one or two actively interested persons cannot be dropped by them after the organization has been put into working condition. One man does the most of the work. He should be familiar with the fisheries of his State and not be prejudiced in favor of either sportsmen or commercial fishermen.

We believe in the social side of the organization as contributing largely to its success, but our membership is too scattered to meet socially more than twice a year.

Mr. Peabody: Mr. Titcomb is perfectly saturated with his subject and is the best posted man on that subject in the country.

The Chair: What is the next paper?

Secretary Whitaker: The next paper is one prepared by Dr. Henry B. Ward, which will now be read:

AQUACULTURAL EXPERIMENT STATIONS AND THEIR WORK.

The United States is justly famed among the nations of the world for the rapid advance it has made in methods of agriculture. Primarily this is, of course, due to the sagacity of the people and to their adaptibility in taking hold of new ideas and applying them to the given conditions in any locality. But a most powerful factor in aiding and directing this development has been unquestionably our admirable series of agricultural experiment stations. In every State and territory in the Union at least one such establishment, founded by State liberality and fostered by generous grants from the general government, is working uninterruptedly at the problem of agriculture in that region. In these stations the subject of agriculture has received, for many years, the closest attention of scientific workers. Not only the character of the different products, their food value for different uses and in connection with the raising of different kinds of stock, but also the preparation and enrichment of the soil, the development of the seed, the growth of the plant, the dangers that threaten it, the diseases that attack it, its protection and improvement, are all subjects of continued investigation.

Contrast with this, if you please, the conditions which exist in fish culture: "Despite the painstaking investigations of a few scientific workers and the encouragement of some official boards with limited means, aquaculture has been almost as much neglected as agriculture has been advanced. The incentive given by the work of Hoy, Milner and Forbes on the Great Lakes a quarter of a century ago has not been followed up; chance has been relied upon to control the conditions in these vast inland seas, and the fundamental features of the problem are as little understood to-day as when there was no drain on the life in these waters. No farmer is so ignorant as to suppose he could scatter the seeds of a grain whose development was entirely unknown over the land of which he was equally ignorant, and leaving the land could hope on his return in the fall to reap a bountiful harvest. And yet this is just what has been looked for in the case of the whitefish." This aspect of the question was very sharply put by Prof. Jacob Reighard in a paper read before the International Fisheries Congress in 1893: "If we inquire into the facts concerning the sufficiency of the present methods of artificial propagation," he says, "we find that so far as the whitefish is concerned, there is no question as to the success of the earlier stages of the process. Several hundred million ova are taken annually and placed in the hatcheries and of these usually from 80 to 90 per cent. are hatched and placed in the waters of the Great Lakes—165,000,000 in Lake Erie alone in 1888.

"This is very nearly all that we know about these young whitefish. About their food habits we know only that in captivity they eat certain species of crustacea. Whether in their natural habitat they eat other animals in addition to these crustacea or in preference to them, we do not know. It is uncertain at what age they begin to feed or how much they require. We do not know their natural enemies. We do not know whether they thrive best in running water or in standing water, in shallow water or in deep water, whether at the surface or near the bottom. What changes of food habits or of habitat the fish undergo as they grow older is still deeper mystery.

"Our problem is to place young whitefish in the Great Lakes under such conditions that as large a number as possible of them shall grow into adult fish. It is clear that of one of the elements in this problem namely, the whitefish, we know but little.

"What then do we know of the other elements of the problem, the Great Lakes themselves? Individual naturalists have, from time to time, made efforts to study one or another of the groups of animals living in the lakes. These efforts have been circumscribed by the facilities at hand by the time that could be devoted to the subject, by the small area examined, or by the small number of animals taken into account. * * * We are thus in the position of bringing together under unknown conditions, two things, both unknown in character; and we expect as a result to get a third thing, marketable whitefish. Should we not pursue our object more intelligently by first determining the characteristics of the materials with which we have to work?"

What Prof. Reighard has said of the whitefish may be said of other species with equal truth. Clearly present methods have reached their limit and the subject must be attacked from a different standpoint. Aquaculture must be given the same sort of treatment that agriculture already receives at the hands of the thousand trained investigators in experiment stations that are located in every State in the Union. It must be studied from the same scientific standpoint; its problems analyzed, its course marked out definitely. As I have said elsewhere in discussing one side of the problem: "Fish culture will never attain its proper results until it receives, by the liberality of the State and nation, the same favors that have been extended to agriculture, the use of permanent and well equipped experimental stations where trained workers shall devote their time and energy to the solution of its problems. The Great Lakes furnish a cheap and valuable food supply to one-third of our entire population; this food supply is rapidly becoming depleted. How long must such important interests wait their just recognition and adequate protection? And if properly developed, who can limit the possibilities of these inland seas in supplying the nation with food? The urgent need of the present is not a mere biological observatory, however valuable such a permanent foundation may be, but a well equipped and well directed experiment station to attack the peculiar problems of fish culture in the Great Lakes.

The idea is by no means entirely novel and much work has been done preliminary to the foundation of such a station. The classic researches of Forbes on fish foods, of Birge on the crustacea of the plankton and of many other individual observers, have opened questions of extreme scientific and economic importance. Some years ago the Michigan Fish Commission, under the able leadership of the Secretary of this society, carried on through several successive summers biological investigations first on the inland lakes of Michigan and later on Lake St. Clair and Lake Michigan. For the past three years Illinois has maintained on the Illinois River a biological laboratory where, under the guidance of Prof. Forbes, the problems of a river system have been undergoing careful investigation. The United States Fish Commission has had for years an important investigating station at Woods Hole, but is work has been largely confined to the summer months. Numerous other less extensive enterprises might be mentioned, but these will suffice to show that the time is ripe for such an undertaking of a more formal and extensive character.

If the establishment of an aquacultural experiment station is advocated one may well inquire as to the most favorable location and as to the work it may be expected to perform. And at the start it may be noted that a single station is but the beginning, for just as agricultural experiment stations are found in every State, so aquacultural stations should be distributed so as to afford opportunities for the investigation of all conditions for the development of life in ocean, lake and stream. For the pioneer enterprise one may justly say that a lake presents the most favorable location. It is, as Forbes has said, a world within itself, a unit of environment and has thus evident advantages over the ocean or stream as a starting point for study. In the Great Lakes I believe we possess such favorable units for investigation, while at the same time the economic questions associated with the depletion of the whitefish are of pressing importance. Almost any location which might be chosen on one of the lakes would also afford within easy reach smaller inland lakes for such comparisons as should prove advisable.

Both the general government and the individual States have already in existence more or less extensive plants connected with the various hatching stations, and these might well be made use of in establishing aquacultural stations with evident saving in equipment and working force, since the expensive pumping apparatus, for instance, would serve with little or no modification for both purposes. The intimate association of the scientific experimentation and the hatching might be expected to redound to the advantage of both. It is also evident that such an aquacultural station would be fitly combined with such a large aquarium as has been advocated in Detroit for some years.

Following along the line of successful work in agriculture, such a station should possess a working force composed of men trained for scientific research and, associated with them, assistants having thorough personal acquaintance with the problems of practical fish culture. The work to be done must be attacked in a thoroughly scientific fashion; no superficial study will really succeed in throwing light upon the problems that are presented. To this end the foundations must be laid broad enough to insure the permanent value of the work. And equally with thoroughness continuity is essential; experiments and observations must extend throughout the year and even through a series of years. Herein lies a real danger of the plan, for ultimate success demands that the work proceed independent of results, while impatience for some return is a most characteristic feature of American life.

If the work of an agricultural experiment station is great, equally so is that of an aquacultural. The latter deals with all conditions of existence which present themselves in the water. It seeks to ascertain of what the food of each fish consists, in what amounts it comes and where that food is found, how the amount may be increased and even how it may be improved by the introduction of new elements imported, it may be, from distant parts of the world. Experimentally it would strive to determine to what extent an increase in the number of the fish was both possible and profitable and how this increase could best be attained. Furthermore, in the light of food supply, the investigator would institute comparisons as to the best kinds of fish to raise under given circumstances, and, not content with this, would endeavor, experimentally, to produce new races of fish and to domesticate suitable forms. It is not necessary to carry this analysis further and I only need to call attention in passing to the patent fact that other living forms than fish are of considerable economic importance on the continent and might well be here. The introduction and improvement of such forms would clearly be one function of such aquacultural stations.

The problems outlined are indeed vast, and yet we may be confident that their solution lies easily within the power of the human intellect, for they are all paralleled in the history of the agricultural development of the race; and man, relying upon his success in the past, may go forward with supreme confidence to the attainment of their solution in this new field.

Mr. Clark: I don't wish to take up the time with any argument, but Prof. Ward's paper is right in the line of what I had been advocating for ten years on the subject of the work of the scientists in this direction on the Great Lakes; that it should be continued from month to month during the year. I have argued that the summer campaign of these men has never developed or brought out what practical fish culturists want to know in regard to the habits of the fish in the great lakes. I think that the scientists are taking a step in the right direction. The scientists and the fish culturists and everybody should keep together.

Prof. Birge: I think the paper puts the rule for the conditions of success, extremely well. I don't believe in a summer campaign. With all due respect to the college professors, I don't think they can do that work permanently. I think the work must ultimately be conducted by men who make it their life work, just exactly as with the agricultural experiment stations. We find in Wisconsin that the men who work in the stations do very little teaching. They hold the rank of professor, but they are expected to do little or no teaching. It is found that a man cannot give his time to the problem of agricultural conditions and at the same time do a large amount of teaching. If the man is going to reach real success in handling these practical problems, he must set up with them day and night, week after week and year after year. What ought to be done is for the United States Fish Commission to establish at least one such station and maintain it, as Prof. Ward says, without any expectation of immediate results of a practical kind, and put men in there to study the problems and find out how they can be established. Such a station would utilize the work of the college professor in the summer, and it would be made available; at the same time the work should be carried on by the regular employes of such station. I don't think that anybody can doubt that such a station must be established. When you try to throw even the small amount of work that we have done on a few, you will find at once the dense ignorance you have, you will find nobody knows anything about it; there are a lot of disconnected observations and knowledge that you can pick up, but when you try to get things together in some shape, nobody knows anything about it and nobody will know anything about it until an enormous amount of work has been done on a great number of different classes of subjects and the whole thing has been brought together by a continuance of the work extending over a good many years and when you once get that you can get practical results; such work as Forbes is at in Illinois is exactly what ought to be done. He is spending about $5,000 a year on the investigation of a single river practically; if he is able to continue that for a long enough time he will get some idea of the condition of fish life in the rivers.

Mr. Whitaker: There is one thing I want to say in connection with this matter. Something like six years ago the importance of this work of scientific inquiry into subjects relating to fish life and culture and the conditions that surround them and have bearing on fish life impressed its importance upon me. The matter was brought to the attention of our board, after a conversation with Prof. Reighard at Ann Arbor, and we determined to establish a field station. A certain amount of money was devoted to that work. The amount of money that was required was very insignificant compared with the value of the work done. It was thought best to make that work permanent, but the economy of the legislature finally compelled us to stop it after having prosecuted it for two or three seasons. I don't think there is any argument needed on the importance of the continuance of this work. It has always impressed itself as a necessity upon me. During his lifetime I interviewed Col. McDonald two or three times on this subject, urging him to take it up, telling him that we would be very glad to surrender the work to the United States Commission, and it was a work that ought to be kept up. At last it has come to the point where the work is liable to be put on a permanent basis. I believe it is going to result in much good to the cause of fish culture. What we want to know is something about the life habits of fish. It would be interesting to know whether there are given areas in the lakes that are stocked with the food of fish more plentifully than others, which would influence the decision as to the most likely places in which to plant fish. Of course, in connection with that there is this question as to the food of the fry. Can we determine anything about the conditions that are necessary to give the best results to be expected from planting? If we can do that we are acting intelligently as fish culturists. We should get at those things which are as important for the fish culturist to know as it is important for the farmer to know the constituents of his soil. It is a fact that this work has heretofore been done in a spasmodic sort of a way and it is a fact that we have been unable to establish anything like a permanent force to carry on the work the year round. It is a fact that the scientific gentlemen who have thus far been active in this work have donated their time and that their vacations have been given up to it, time they ought to have devoted to getting a little fresh air into their lungs. But we find that the scientist is a very peculiar animal, that he enjoys spending his vacation in labor that is congenial to him; he does not seek to resort to the green field nor care to throw himself under the spreading branches of the oak and read a dime novel. His idea of recreation appears to be to get out and prosecute some independent and original work, all of which is very gratifying, I have no doubt, but unless some good systematic plan of work is adopted and carried on regularly, such work will be of little practical benefit to fish culture. Of course there are many collateral inquiries necessary, but we first ought to follow out the life history of the fish. The establishment of a good station for scientific study on the Great Lakes would probably result in a summer school such as we now have at Woods Hole. I think it is a matter of congratulation that something is now promised on the lakes similar to that now done on the ocean. In good hands and with permanent workers, eventually this work will redound to the benefit of fish culture, and I will welcome it as sincerely as anyone can.

Mr. Peabody: There was some talk last year of a convention of representatives of the States on the Great Lakes, regarding the matter of protection to the fisheries. Has anything been done?

Mr. Whitaker: That matter was left in the hands of the President. That information would more properly come from him.

Mr. Peabody: I would like to ask if the membership of this society is confined to residents of the United States. Its name is the American Fisheries Society; is there anything that would prevent securing members from abroad or in Canada?

Mr. Whitaker: No, America embraces it all.

Mr. Peabody: I don't know but it would be well to offer a resolution that the governors of the States bordering on the lakes appoint delegates to meet with this society at our meeting at Niagara Falls, and have them listen to the discussion regarding the ideas of fish culturists. Some of the governors of the States on the Great Lakes know nothing of this society. Can we not arrange in some way to have them meet with us? I don't know what has been done, but cannot something be done by which we can have that matter come to a head next summer at Niagara Falls?

Mr. Whitaker: I took occasion to write to Prof. Prince, of the Canadian Fishery Department, asking him to participate personally in this meeting, or by a paper. I never even received an acknowledgment of the letter.

Mr. Dale: Let Mr. Peabody as President and Mr. Whitaker as Secretary, issue a circular letter to the gentlemen living in Canada who are interested in fish culture, inviting them to attend the meeting in Niagara Falls.

President May: Do you want the society to take action on it at this time?

Secretary Whitaker: I will send an announcement of this meeting to those gentlemen.

Mr. Peabody: Now regarding the States bordering on the lakes, why wouldn't it be a good plan for the Secretary to communicate with the governors of those States, arranging for representatives from the lake States to attend the meeting at Niagara Falls?

Mr. Whitaker: Why not make a motion that the Secretary be authorized to communicate with the governors of all the States a sufficient time prior to the next meeting, calling their attention to this Society, its aims and objects and the desirability of having them appoint delegates to attend the meeting?

Mr. Peabody: I have drawn up and offer a resolution that the governors of all the States appoint delegates to be in attendance at the next meeting.

The resolution was supported and unanimously carried.

Secretary Whitaker: In that connection I want to say one word; the work in the office of Secretary is considerable, heretofore I have done all of it myself, this coming year I shall employ such force as is necessary; I think it is due the Society that I should state this.

Mr. Peabody: I will call for a resolution, providing that the Secretary be allowed $100.00.

Mr. Whitaker: I don't think that should be done.

Mr. Clark: I think the Secretary should have full power to use his judgment in those matters.

Mr. Whitaker: I shall not employ assistance except when it is necessary. I shall not abuse the privilege. The amount paid out for running the office last year was about $50.00 to $55.00, and I did most of the work myself; this year I must have some assistance.

I wish to offer the following: This Society learns with pleasure that steps have been taken by the Commissioner of Fisheries of the United States to establish on the Great Lakes a permanent station for scientific inquiry. We recognize the importance and necessity of this work, and the practical bearing its investigations must have on many of the questions affecting fish culture and its success as an economic problem, therefore,

Resolved, That in the opinion of this Society the importance of this work is such, that we ask the Congress of the United States to grant the necessary funds to place this work upon a liberal and broad basis so that the work of the artificial propagation and distribution of the important food fishes of the lakes may be carried on with a thorough understanding and familiarity with the conditions surrounding the fisheries and their needs as will lead to the greatest success of that work.

Prof. Birge: I move the adoption of that resolution.

The resolution was unanimously carried.

Mr. Whitaker: I wish to say that I communicated to Mr. Fred. Mather the fact that at our last meeting he had been elected an honorary member of the Society and received a letter from him in reply in which he desired me to extend his thanks for the courtesy shown him and to express a due sense of his appreciation for the honor.

Mr. Clark: As there was a great deal of talk at the time we reduced the dues of getting a great many new members, which I have no doubt will be done, I would suggest that it might be a good idea for every one to get as many new members as they can and send their names to the Secretary between now and the time our report is ready to be sent out so that these new applicants may receive the report. Would not that be a good idea? I know I could send in the names of four or five that would want the book.

Mr. Whitaker: The Secretary last year on his own responsibility inaugurated that system. I held this out as an inducement to new members, that they would get the benefit of two years' membership for one year's dues.

There is another thing I want to give notice of. I shall bring up at the next meeting an amendment to the constitution.

The constitution as it now stands allows the names of delinquent members to stand on the rolls for three years. I shall move to amend by cutting it down to two years.

Mr. Dale: Before we adjourn I think we had better adopt a resolution of thanks to the officers of the Trans-Mississippi Exposition and the Mayor of the City of Omaha, for the courtesies extended to this Society at this meeting.

On motion Mr. Dale and Prof. Birge were appointel to present a suitable resolution of thanks to the officials of the City of Omaha, the Press and the Exposition officials for courtesies extended the Society, and they reported as follows:

Resolved, That the hearty thanks of the American Fisheries Society be extended to the Mayor of Omaha for the cordial welcome given the Society, through his secretary, and for the keys of the city, opening the doors of its hospitality, rendering our stay here both pleasant and profitable.

The thanks of the Society are also extended to the public press of Omaha for the excellent reports and notices of our meetings.

We desire to thank the officials of the Trans-Mississippi Exposition for the privilege extended to the members in attendance upon this meeting, of free admission to the exposition at all times. We congratulate the management upon the happy culmination of its efforts to present to the people of this country an exhibition which is only second to the Columbian Exposition in the beauty of its buildings and grounds, and upon the creation of such a magnificent exposition of the material resources and wealth of the giant west. Here, grouped about the Grand Central Court of Honor are buildings of rare architectural beauty filled with exhibits of industrial skill, of mineral wealth, and with the agricultural products of a territory laid down upon the maps of a quarter of a century ago as embraced in the great American desert, evidencing in a marked degree the fertility of a soil which only needs the hand of the husbandman to furnish proof of its inexhaustible resources. To the management which has conceived and brought forth so grand an achievement we feel that the highest praise is due.

On motion, the Society then adjourned to meet at Niagara Falls, N. Y., June 28th and 29th, 1899.

LIST OF MEMBERS.

ACTIVE.

Adams, E. W., 114 Wall st., New York.
Alexander, L. D., 50 Broadway, New York.
Alexander, Geo. L., Grayling, Mich.
Amsden, F. J., Rochester, N. Y.
Anderson, J. F., 240 Eleventh st., Jersey City, N. J.
Annin, Jas., Jr., Caledonia, N. Y.
Atkins, Chas G., East Orland, Me.
Ayer, F. W., Bangor, Me.
Babbitt, A. C., Sault Ste. Marie, Mich.
Babcock, C. H., Rochester, N. Y.
Ball, E. M., Put-in-Bay, O.
Barrett, W. W., Church's Ferry, N. D.
Bartlett, Dr. S. P., Quincy, Ill.
Bell, Currie G., Bayfield, Wis.
Belmont, Hon. Perry, 19 Nassau st., New York.
Benkard, James, Union Club, New York.
Bickmore, Prof. A. S., Am. Museum Natural History, New York.
Birge, Prof. E. A., Madison, Wis.
Bissell, J. H., Detroit, Mich.
Blackford, E. G., Fulton Market, New York.
Booth, A., cor. Lake and State sts. ,Chicago, Ill.
Bottemanne, C. J., Bergen op Zoom, Holland.
Bower, Seymour, Detroit, Mich.
Bowman, W. H., Rochester, N. Y.
Bradley, Dr. E., 19 West 30th st., New York.
Brice, Col. J. J., Mare Island Navy Yard, Cal.
Brush, Dr. E. F., Mount Vernon, N. Y.
Brown, Geo. M., Saginaw, Mich.
Bryant, E. E., Madison, Wis.
Bulkley, H. S., Odessa, N. Y.
Buller, N. R., Mauch Chunk, Pa.
Bumpus, Prof. H. C., Providence, R. I.
Cary, Dr. H. H., Lagrange, Ga.
Cheney, A. N., Glens Falls, N. Y.
Clark, Frank N., Northville, Mich.
Crook, Abel, 99 Nassau st., New York.
Crosby, H. F., P. O. Box No. 3714, New York.
Dale, J. A., York, Pa.
Davis, B. H., Palmyra, New York.
Davis, H. W., Grand Rapids, Mich.
Davis, Hon. G. B., Utica, Mich.
Demuth, H. C., 144 E. King st., Lancaster, Pa.
Dickerson, F. B., Detroit, Mich.

Dourcdoure, B. L., 103 Walnut st., Philadelphia, Pa.
Doyle, E. P., Port Richmond, N. Y.
Ebel, Hon. F. W., Harrisburg, Pa.
Ellis, J. F., U. S. Fish Commission, Washington, D. C.
Emerick, H. F., San Francisco, Cal.
Fox, J. C., Put-in-Bay, O.
Friesmuth, E. H., Jr., 151 North 3rd st., Philadelphia, Pa.
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Gavitt, W. S., Lyons, N. Y.
Griffith, S. L., Danby, Vt.
Gunckel, J. E., Toledo, O.
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Haley, Caleb, Fulton Market, New York.
Hamilton, Robert, Greenwich, N. Y.
Hansen, G., Osceola Mills, Wis.
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Holden, H. S., Syracuse, N. Y.
Hoxie, J. W., Carolina, R. I.
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Hurlbut, H. F., East Freetown, Mass.
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Johnson, S. M., Union Wharf, Boston, Mass.
Jones, Alexander, Wood's Hole, Mass.
Jones, Dr. O. L., 116 West 72d st., New York.
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Keene, J. H., Baltimore, Md.
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Marks, H. H., Paris, Mich.
Marks, J. P., Paris, Mich.
May, W. L., Omaha, Neb.

Meehan, W. E., Public Ledger, Philadelphia, Pa.
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Milbank, S. W., Union Club, New York.
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Post, Hoyt, Detroit, Mich.
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Powers, J. W., Paris, Mich.
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Preston, Hon. J. L., Port Huron, Mich.
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Ravenel, W. de C., U. S. Fish Commission, Washington, D. C.
Ricardo, George, Hackensack, N. J.
Rosenburg, A. C., Kalamazoo, Mich.
Rowinville, E. T., East Freetown, Mass.
Ruge, John G., Apatachicola, Fla.
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Stranahan, H. B., Cleveland, O.
Stranahan, J. J., Put-in-Bay, O.
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Wilmot, Samuel, Newcastle, Ont.
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Wood, C. C., Plymouth, Mass.
Zweighalt, S., 104 West 71st st., New York.

HONORARY.

The President of the United States.
The Governors of the several States.
Borodine, Nicholas, Delegate of the Russian Association of Pisiculture and Fisheries, Uralsk, Russia.
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Mather, Fred, 63 Linden st., Brooklyn, N. Y.
Southside Sportsmen's Club, Oakdale, L. I., N. Y.
New York Association for the Protection of Fish and Game, New York City.
Lake St. Clair Shooting & Fishing Club, Detroit, Mich.
Woodmont Rod and Gun Club, Washington, D. C.
Fish Protective Association of Eastern Pennsylvania, 1020 Arch st., Philadelphia, Pa

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, Viborg, 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.

Macleay, 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.

Division of Fishes,
U. S. National Museum

Transactions

American

Fisheries Society

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PROCEEDINGS

OF THE

AMERICAN FISHERIES SOCIETY

TWENTY-EIGHTH ANNUAL MEETING

HELD AT THE

INTERNATIONAL HOTEL

NIAGARA FALLS, N. Y.

WEDNESDAY and THURSDAY, JUNE 28th and 29th, 1899

LANSING, MICH
ROBERT SMITH PRINTING CO.
1899

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MINUTES OF THE 28TH ANNUAL MEETING OF THE AMERICAN FISHERIES SOCIETY.

INTERNATIONAL HOTEL, NIAGARA FALLS, NEW YORK, JUNE 28 AND 29, 1899.

The meeting was called to order by President Peabody at ten o'clock a. m.

The following old and new members were in attendance at one or more of the sessions:

District of Columbia, George M. Bowers, W. de C. Ravenel; Kentucky, J. Hub Prather; Maryland, A. F. George; Michigan, J. B. Reighard, F. B. Dickerson, Frank N. Clark, J. L. Preston, Herschel Whitaker, Dr. J. C. Parker, Seymour Bower; New York, W. H. Bowman; Ohio, J. J. Stranahan, J. E. Gunckel; Oregon, S. W. Downing; Pennsylvania, J. A. Dale, B. L. Douredoure; Rhode Island, H. C. Bumpus, Henry T. Root, C. W. Willard, Wm. J. Morton, O. D. Roberts; Vermont, John W. Titcomb; Wisconsin, George W. Peabody.

During the meeting the following gentlemen were elected to membership in the Society:

Benton, W. H., Bullochville, Ga.
Bowers, Hon. George M., Washington, D. C.
Brewer, W. C., Cleveland, O.
Curtis, J. M., Cleveland, O.
Dinsmore, J. H., St. Johnsbury, Vt.
Downing, S. W., Stone, Oregon.
Filkins, B. G., Northville, Mich.
George, Hon. A. F., Swanton, Md.
Hughes, Frank L., Ashland, N. H.
Kerr, T. R., Pittsburg, Pa.
Kiel, W. M., Carolina, R. I.
Mancha, H. H., Northville, Mich.
Marsh, M. C., Washington, D. C.
Merrill, M. E., St. Johnsbury, Vt.
Miller, G. F., Put-in-Bay, O.
Miller, W. S., Gallion, O.
Moore, C. H., Detroit, Mich.
Morse, Grant M., Portland, Mich.

Morton, W. P., Providence, R. I.
Mussey, George D., Detroit, Mich.
Orr, W. J., Bay Port, Mich.
Prather, J. Hub, Lexington, Ky.
Roberts, A. D., Woonsocket, R. I.
Robinson, W. E., Mackinaw City, Mich.
Root, Henry T., Providence, R. I.
Smith, L. H., Algona, Iowa.
Southwick, J. M. K., Newport, R. I.
Starbuck, Alexander, Cincinnati, O.
Sterling, J. E., Crestfield, Md.
Stewart, A. T., Northville, Mich.
Thayer, W. W., Detroit, Mich.
Tawes, J. C., Crestfield, Md.
Tubbs, F. H., Neosho, Mo.
Wallett, W. H. Put-in-Bay, O.
Willard, C. W., Westerly, R. I.
Williams, J. A., St. Johnsbury, Vt.
Wilson, S. H., Cleveland, O.
Wires, S. P., Duluth, Minn.
Zalsman, Philip G., Paris, Mich.

Secretary Whitaker:

Mr. President and Members of the Society: I received a letter from the Treasurer of the Society something like a week ago saying that his family had been sick for about a year, that he hoped, however, to be present at this meeting. This morning, on my arrival here, I am in receipt of a letter stating that he is unable to come, and that he has forwarded by express his report to me here, at the hotel. It has not reached here yet, and it will become necessary for someone to be appointed to act temporarily in his stead. I move that Mr. Douredoure of Philadelphia be appointed to act as Treasurer pro tempore.

The motion was seconded and carried.

President Peabody: In calling the meeting of the American Fisheries Society to order the President has no report to make, other than to congratulate those present upon the large number here, in consideration of the fact that most of us come five or six hundred miles to this meeting which has no gifts or emoluments to offer. Those who come here come for the love of the purposes of the Association. The meeting is now open for the transaction of business.

Secretary Whitaker: Mr. President, it has been customary for this Society to meet in different places on the invitation of some city, which has usually provided for our entertainment. We are not so situated here, but we are at a place of exceeding interest, and I have no doubt the members will desire during their stay to take advantage of the opportunity to visit some of the objects of interest about Niagara Falls. It is within the province of this Society to dictate the time of its sessions. Personally, there are places I should like to visit, and I have no doubt others would like to do the same. It might be well for us to fix our times of meeting so as to convenience the members and intersperse such visits with the business meetings. We are not absolutely restricted to two days attendance here. I suggest this, so that you may understand the situation and govern yourselves accordingly.

President Peabody: It might be proper to have a committee appointed to arrange the hours of the meeting and the extent of the session. If there is no objection, I will appoint Mr. Willard, Mr. Titcomb and Mr. Bower as such committee.

Mr. Bumpus: I move that the Chair appoint a committee of three to examine and report upon the names presented for membership.

The motion was duly seconded and was carried.

The President appointed as such committee Messrs. Dale, Bumpus and Gunckel.

President Peabody: The next thing in order will be the Secretary's report.

Secretary Whitaker:

Mr. President, and Members of the Society: The Secretary has no formal report to make for the year. The ordinary details connected with the office of the Secretary have been performed. The minutes of the meeting were gotten out and distributed to the members, I believe, within sixty days of the close of the meeting. While I am on this subject, I wish to make a motion that the minutes of the last meeting, as they appear in the printed record, be accepted and adopted as the report of the last meeting.

The motion was seconded and carried.

Secretary Whitaker: Continuing, I wish to say that at the last meeting there was a motion made that the Secretary be directed to communicate with the Governors of the different states, asking them to send representatives to the meeting at Niagara Falls. Something like two months ago, or perhaps a little less, I prepared such a formal address and sent it to the Governors of nearly all the states, and I also sent copies to other parties who I thought would be interested. The response to those circulars was very gratifying indeed. The Governor of Kentucky sent me something like twelve or fourteen names of men whom he had appointed to officially represent his state at this meeting. The Governor of New Mexico, the Governor of Idaho, and several other Governors did the same thing; and the evidence of the wisdom of passing that resolution is manifested here today in the increased attendance and in the number of new faces we see here. The American Fisheries Society is to be congratulated upon its reinforcement by these gentlemen, who have come such a long distance; and I am sure we all hope that they will experience benefit to the extent of the pleasure that we shall experience in associating with them. I have several letters of regret from members who are unable to attend.

The Secretary here read letters of regret from Professor Henry B. Ward, of the University of Nebraska; Hon. W. W. Barrett, Dakota; Mr. W. L. May, and Messrs. Huntington, Meehan and Birge.

Secretary Whitaker: I believe that this is all the report that I have to make at this time.

Mr. Gunckel: Mr. President, I believe it is customary for all officers to make a report, and I being an officer want to make such a report. I can not use the fine language these gentlemen use, because they are trout fishermen and understand how to get everything from nature that can be procured. I am only a common black bass fisherman. I have caught, I think, the largest black bass that was ever caught in Lake Erie, and my witness is Mr. Stranahan, a very distinguished gentleman. As you know, I am Corresponding Secretary, and have been for two years. During the last year I have had a great deal of correspondence with foreign members, with gentlemen greatly interested, in London and throughout the United States. I have had quite a number of letters making inquiries and letters from gentlemen desiring to become members. These I send to the Secretary, and when questions of a scientific nature are propounded to me I send those that I can not answer also to the Secretary. Anything easy about the catching of perch, and that sort of thing, I answer myself, but these scientific questions I turn over to the Secretary and request him to answer. I volunteer this report simply to show that I did something in the performance of my duties during the year.

Secretary Whitaker: I move that a committee of three upon the nomination of officers for the ensuing year be appointed by the chair.

Mr. Clark: I would support the motion of Mr. Whitaker in regard to the committee on nominations, if he will make it a committee of five.

Secretary Whitaker: I will accept the amendment.

The motion, as amended, prevailed, and the President stated he would announce the committee later on.

Mr. Gunckel: I move that a committee of three be appointed to select a place of meeting next year.

The motion was duly seconded.

President Peabody: Before that motion is put, it might be proper to listen to invitations or suggestions that might serve as a guide to the committee in selecting the location.

Mr. Bower: I suggest that the committee give a hearing, and such suggestions and invitations be made at the hearing.

Mr. Bumpus: I move that what has just been said be interpreted as instructions to the committee. I second the motion with that understanding.

President Peabody: It is understood, then, that the committee will give a hearing.

The motion prevailed, and the President announced that the committee would be designated later.

Mr. de Ravenel: Mr. President, I would like to ask whether any of the State Fish Commissions here represented expect to make an exhibit at the Pan-American Exhibition to be held in Buffalo in 1901. I represent the United States Fish Commission there, and have recently attended a meeting of the Government Board in Buffalo, and we are arranging for a very interesting aquarium exhibit. We want to make it the best live fish exhibit that has been made in this country at any exhibition, not excepting the World's Fair, and if any State Commissions have appropriations for that purpose, or for any other purposes, as far as the exhibition of fish is concerned, I would like, in behalf of the Exposition people and the United States Fish Commission, to ask that they co-operate with us rather than put up an opposition show. This does not pertain strictly to the American Fisheries Society, but I thought it would be well to bring the question up and call it to the attention of any gentlemen who might be interested. I think if they propose to go into it that with the means now at our disposal we can put up an aquarium, and in fact pay all the expenses.

Some further discussion ensued in reference to the fishery exhibit at the Pan-American Exhibition and the Paris Exposition, after which the President announced as the committee upon the place of meeting Messrs. Titcomb, Gunckel and Dale; as the committee on nomination of officers, Messrs. Whitaker, Bumpus, George, Clark and de Ravenel.

On motion duly seconded the Convention adjourned until 2 p. m.

AFTERNOON SESSION.

President Peabody called the Convention to order at 2 o'clock, and called for the report of the committee on place of meeting.

Mr. Titcomb: Mr. Chairman, your committee has had several propositions and invitations, and Commissioner George of Maryland has suggested that we come to Mountain Lake Park, and has presented the advantages of the place. We understand that the President, representing the Wisconsin Commission, has offered inducements and invited us to Milwaukee; that Mr. Whitaker has presented letters from Governor Pingree and others, inviting us to Detroit or Lansing. Dr. Parker invites us to Grand Rapids, and the United States Fish Commission, represented by Dr. Bumpus, invites us to Woods Hole. We have canvassed the different places mentioned, and we think Woods Hole will be the best place to meet, for several reasons. It will give us an opportunity to visit the hatchery of the United States Fish Commission, where they are propagating marine fishes; there is a biological station where scientific work is going on, and there are many professional and scientific men who would naturally join the society if we meet at that place. I am well aware that the Commissioner, in his generous heartedness, has great plans of hospitality for us and will present all facilities of the commission in the way of boats, etc., so that we can get around to see the work that is going on there. In view of all the circumstances, your committee respectfully recommend that the next meeting be held at Woods Hole some time in July. The second week has been proposed, and that seems to be a convenient time, especially to superintendents of stations, as the fiscal year ends the 30th of June and all have to prepare extensive reports.

Mr. Willard: I move that the recommendations of the committee be adopted.

Mr. Clark: Mr. Chairman, I would submit the suggestion that possibly voting on this subject ought to be laid over until after the election of new members, so that they may have an opportunity to vote.

President Peabody: If there are no objections, then, we will first have the report of the committee on membership regarding the names presented.

Secretary Whitaker: I move that the gentlemen whose names have been presented be elected to membership.

The motion was duty seconded and was unanimously carried.

President Peabody: The question is now on the adoption of the report of the committee on location for next year.

Mr. Clark: Mr. Chairman, I am heartily in accord with the views of those who have made this report, but I can not let it pass without calling to the minds of the members the partial promise we gave our friends from Wisconsin last year at Omaha. They were very much in favor of our coming there this year, and the members who were in attendance gave them a partial promise that we would endeavor to have the meeting there this year. I, with the rest, gave that promise. Of course, I would like to go to Woods Hole, but I wanted to call the members' attention to this fact.

President Peabody: That is very generous and considerate, but I will answer for the Wisconsin delegation that we will waive our rights in this matter. I think that we would all like to go to the Atlantic.

The President put the question upon the motion as made, and the same was duly carried.

President Peabody: Professor Bumpus has prepared a paper and has his material, which is perishable, for an object lesson, and we have put him first on the list for that reason.

METHODS AND RESULTS OF SCIENTIFIC WORK AT WOODS HOLE.

BY PROFESSOR HERMON C. BUMPUS.

In this paper it will be our purpose to describe only those methods which have been more recently adopted at the marine laboratory of the United States Fish Commission, and to note only those results of scientific work which have a distinctly economic bearing.

It will be remembered that in 1884 Professor Baird saw the completion of the station, the largest, and in many ways the most thoroughly equipped, plant for the observation of marine life in the world. During the summers of 1884-6 the entire department was transferred from Washington to Woods Hole. The rooms in the Residence were filled with executive officers, men of science, and clerical assistants; the laboratories were occupied by such investigators as Professor A. E. Verrill, Sidney I. Smith and W. S. Faxon; and the entire fleet of the Commission was busy in carrying on those lines of exploration which made the work of the United States Fish Commission the pattern for other nations to follow. But as the laboratory at Penikese profited by the directorship of Louis Agassiz for only one season the station at Woods Hole enjoyed the directorship of its founder only a brief period. During the years that immediately followed the death of Professor Baird, the station gave less and less attention to scientific work, until in 1897 the laboratories were actually closed. During the period of waning scientific activity, the station passed through all the stages of material decay. Not only were the laboratories deserted and the scientific equipment destroyed, but the buildings became unoccupied, the vessels of the commission seldom made their appearance, and the wharves and basins reached a stage of disintegration wherein they were picturesque but of little practical value. In the meantime the work of fish-hatching had continued, but only along the old lines and in the perfunctory way that prevails for those who take no vital interest in their work.

I believe that the history of the Woods Hole Station during its dark ages of scientific inactivity will be the history of every station and sub-station that attempts to confine its energies to the merely mechanical work of hatching fish. Close up your drafting room, and your machinist becomes a blacksmith; do away with your schools of design, and the standard of even your so-called practical builder is immediately lowered. More progress has been made in practical medicine during the past twenty-five years than during the previous twenty-five centuries. Who shall say that the progress is not the direct result of laboratory activity and the application of scientific method? The scientific and practical work of a fisheries station cannot be divorced.

On his appointment, the present Commissioner, the Honorable George M. Bowers, recognizing the intimate relation that exists between science and practice, reopened the laboratory which Professor Baird had founded, made generous appropriations for the purchase of scientific apparatus, attached suitable vessels to the station, and invited the naturalists of the country to take up their abode at Woods Hole, and enjoy its privileges. Viewed only in the light of expediency, this action brought to the Commissioner the support of men of science throughout the country. With this support he was enabled to induce Congress to appropriate funds sufficient to put the neglected station in repair, to purchase a new vessel, to provide extensive apparatus for the capture of fish, to more completely equip the laboratories, enlarge the library, increase the staff, and, I think I am justified in adding, to secure the largest appropriation for fish hatching that had ever been made. At the present writing five steam vessels, large and small, are busily engaged at Woods Hole, and fully forty men of science have taken places in the laboratories. Of this willing corps of workers, many are busied with problems of direct interest to the Commission.

For years the fish retained in the aquaria at the station have suffered with what has been known as the gas-bubble disease. The cause of this disease remained entirely unknown, and efforts toward its prevention were ineffectual, until the problem was taken up by a bacteriologist, not in the employ of the commission, but merely enjoying the opportunities of the station. Professor F. P. Gorham found that the disease was not the result of bacterial invasion, but that it resulted from the reduction in pressure on the natural gases of the body, which took place when fish habituated to a life in deeper water were transferred to the shallow water of the aquaria.

The large fish-traps operated by the station have furnished a sufficient amount of material to enable Professor Edwin Linton of Washington and Jefferson College to pursue his investigations on fish parasites, and his contributions have materially increased our knowledge of parasitology. It is of prime importance that the fish culturist should be acquainted with the entozoa which may invade the hatchery, but it is still more important that the public should be acquainted with the life-history of animals that may also infect man.

The sea traps, just mentioned, have also provided Professor Ralph W. Tower with the abundant material necessary for his observations on the causes of decay in fish, and methods of arresting decay without the use of ice. Professor Tower's work has been carried on under the direction of the Rhode Island Commission of Inland Fisheries. He has shown conclusively that fish carefully handled will keep absolutely fresh for twenty-four hours, under the most trying climatic conditions without the use of ice. When we consider the large sums of money that the commercial fisherman is obliged to pay for ice, and the heavy charge for expressage on the same, the importance of these investigations becomes more evident.

Buzzards Bay and Narragansett Bay are tracts of water of about equal area, lying side by side along the southern coast of New England, and having very similar physical characters. The Commissioners of Massachusetts have seen fit to prohibit the use of fish-traps and weirs in Buzzards Bay, while the Commissioners of Rhode Island allow free fishing privileges to the inhabitants of the state. The launches of the station at Woods Hole have been used to secure data relative to fisheries conditions prevailing in the two bodies of water, and while several years may be needed to definitely settle the matter, it must be admitted that line fishermen are quite as successful in Narragansett Bay as they are in Buzzards Bay, for all that they compete with one hundred and fourteen traps in the one locality and none in the other.

The Woods Hole Laboratory has furnished Professor C. J. Herrick of Dennison University with material that has enabled him to trace with accuracy the origin and distribution of the cranial nerves, and Dr. Ira van Gieson of the New York Pathological Institute has been provided with material of use in elucidating certain problems relating to the structure and functions of nerve cells. While these neurological researches have no bearing upon fish culture, and only a remote bearing upon the scientific problems ordinarily studied at the station, it is a narrow view that would limit the scope of research to that only which deals with fish for food and fish for sport. If the wealth of marine life that is brought to a laboratory can be of use in the solution of biological problems, and if the study thereupon does not interfere with the immediately practical work of the station, it should be encouraged, for the efficiency of the Commission is thereby increased.

Last fall the water of Narragansett Bay suddenly turned a deep red, and emitted an almost unbearable odor. Fish were killed, even eels sought the shore, and dead shrimp were washed up in windrows. The need of a specialist was keenly felt, for the cause of the bloody water was quite unknown. With the advice of my colleagues on the Rhode Island Commission, Dr. A. D. Mead, a man specially trained in microscopical work, was employed to investigate the matter. A species of *Peridinium* was found to have caused the mischief. We were advised that the trouble would probably be only temporary, and manufacturers who are obliged to pour waste dyeing material into the waters of the bay were exonerated. Now comes the further economic bearing.

Soon after the enemy was really known, word was received at Washington that the oysters in the Chesapeake were turning a deep red color, and cautious dealers were disinclined to buy. It was an easy matter to show that the red oyster had been feeding upon *Peridinium*, that the flesh was not impaired thereby, and that the discoloration would in all probability last for only a brief period.

It will be remembered that in 1880 and 1881 Professor Baird was greatly interested in the development of a tilefish industry, the tile having been discovered in great numbers off the shore of southern New England, but a few hours' sail from the markets of New York, Boston and Newport. In the spring of 1882 these fish were practically exterminated, their dead bodies covered hundreds of square miles of the ocean surface, and subsequent efforts to find the fish resulted only in the discovery of scattered individuals. Last summer a body of scientific men sailed from Woods Hole in the schooner Grampus, for the purpose of again testing the tilefish ground. The very firsh haul of the trawl brought several beautiful specimens to the surface. Thus encouraged, the Grampus continued her work through the summer, capturing hundreds of the fish, and never once setting the trawls in vain. The tile is an excellent food fish, rivaling the halibut in flavor and keeping qualities, and the establishment of a tilefish industry will more than pay for what the Commission may have expended for scientific work.

The oyster culturists of the north are sadly persecuted by the starfish. The pest appears in countless numbers, and destroys thousands of dollars' worth of property. That the wholesale seining of the menhaden has a direct bearing upon the oyster industry was never suspected until the researches of Professor Mead, carried on in Narragansett Bay and at Woods Hole, proved beyond peradventure that the young of the starfish, at times so abundant that they actually color the water, are the natural food of the menhaden, the schools of which form a living skimming net, often a mile in breadth. The menhaden, as is well-known are in turn captured by the steam sailing vessels in countless numbers. I think it is perfectly justifiable to ascribe the rapid increase in the number of starfish to the rapid decrease in the number of their natural enemies, through the destructive methods of steam seining.

For several years the clam industry of the north has rapidly deteriorated. A survey of the literature reveals a deplorable condition of ignorance respecting the breeding habits of the clam, its rate of growth, time of sexual maturity, food, enemies, etc. Professor J. L. Kellogg was engaged to investigate the entire question. He worked at Woods Hole and in Narragansett Bay, and reported to the Rhode Island Commission. The results of his labors show:

1. That there is an abundance of young clams. During July the shores are literally covered.
2. These young clams are destroyed by young stars, which appear on the shores at about the same time that the clams appear.
3. The young clams take kindly to artificial rearing.
4. The rate of growth is rapid.

With these data the Rhode Island Commission has seriously undertaken artificial clam culture, and the experiments thus far made have fully warranted their expenditures. When one considers that an acre of clam land would probably produce 174,240 clams, which at six cents each (the price at which they were selling in New York last March) would yield $10,454, the relative productivity of clam beds in New England and orange groves in Florida becomes impressive.

Perhaps no industry is more in need of intelligent treatment at the present time than the lobster industry. During the past three of four years lobsters have become increasingly infrequent, and unless something is done to change the curve of destruction or elevate the curve of production, a few years will see the animal exterminated.

The eggs stripped from the female readily develop and hatch in McDonald jars, but the young quickly perish under the unnatural environmental conditions of the hatchery. The mere planting in the ocean of the young during their free-swimming stages is of questionable value, although it is to be commended so long as egg lobsters are sent to market or stripped by the fishermen to evade the payment of justifiable fines.

If the young could be artificially brooded until they reach the fourth stage, when they are in the habit and structure more like the adult, they would be more likely to flourish after their liberation from the hatchery, and the industry might then become rehabilitated. During the present season we have found a food that the young readily devour, we have designed enclosures within which they seem to flourish, and we have a larger number of young in advanced stages of development than ever before; but the problem is still unsolved, although I have no doubt that continued investigation will finally result in the discovery of a practical method of lobster culture.

In this report I have briefly outlined some of the results of our scientific work for a single year, and I have endeavored to indicate certain lines for its further development. Those who have attempted similar work know how many failures await the investigator, how reluctantly nature reveals her secrets, and how difficult it is to secure enthusiastic assistants, but in compensation how pleasurable is the sensation when one has really overcome a difficulty and is then ready to proceed to the next point of obstinacy.

DISCUSSION ON PAPER OF PROFESSOR BUMPUS.

Mr. Ravenel: I would like to say to Dr. Bumpus, in reference to the lobster question, that the Commissioner, on recommendation of Dr. Smith, who is in charge of the scientific work of the commission, thought that he had arranged this spring for the erection of a large pond to carry three or four million lobsters to the fourth stage, or, in fact, as far as possible; but the point selected proved unsatisfactory, the expense involved in fitting it up was greater than had been anticipated, it was inaccessible, and we are obliged to abandon the plan this spring. It is the intention of the Commissioner that a suitable point be found this summer, and that the work shall be carried to its logical conclusion next year. I desire, also, as one deeply interested in fish culture, to endorse all that Dr. Bumpus has said on the subject of scientific work in connection with fish culture. Without it we are absolutely powerless. We all know that stations are swept out of existence by disease today that the fish culturist has so far been unable to combat, nothing being written on the subject, and we have to look to the original investigator to solve those problems for us.

Mr. Titcomb: It is the custom, I believe, to ask questions after these papers are read. I did not quite gather what the food is that you fed the lobsters, if you stated it in the paper.

Mr. Bumpus: I did not state. We have spent considerable time in finding suitable food. Of course the young lobsters are pelagic; that is, it is natural for them to swim about in the ocean, and they are carried along by the current and pick up small organisms. We have tried to feed them with the skimmings we have taken from the surface, but in the laboratory up to the present time they have not done very well with that food. I think we have probably tried a hundred or more different things, but the digestive gland of a full grown lobster is made up of a number of little threads like fingers if you look at it under a microscope; and if you take this digestive gland and break it up into small pieces—we first shake it in a glass till it is shaken apart—those little morsels are just the right size for a little lobster's mouth; but the air that gets in when you shake the digestive gland, or the liver, as it is called, makes the pieces so light that they tend to float on the surface and a young lobster will not take food from the surface; he will not ordinarily take food from the bottom; it is the food that is sinking down through the water, slowly, that excites his appetite; but if this liver is put onto a board and then a knife is taken and you cut it up into microscopic pieces and are careful to rinse that off, fill a flask and allow it to settle and pour off the supernatent fluid, and then wash again, so that you are not throwing wholly organic matter into the water you can take a little pipette full and squirt a little into these jars that hold the young lobster, and in about an hour you will notice a little yellow ball on the interior of each one, that means that its little stomach is just as full of that lobster liver as it will hold, and I assure you that those young lobsters are immediately to be distinguished from those lobsters which have been injured in the hatching process, or which, for some reason or other do not eat, and will undoubtedly die. But by far the larger number of lobsters will take the food, and the color of the jar as it stands on the table is very different from the color of the jar that contains young lobsters that have not fed. There are probably two or three thousand in this jar.

A Member: What is the form of this fourth condition that you speak of?

Mr. Bumpus: The fourth stage is very different from the stage that immediately precedes it. You would not take them for lobsters at all. The first three stages are more shrimp-like, and they have external gills that make the interior of the body look very fuzzy, or like chenille, as they move through the water. The rapidity of growth and the molting depend upon temperature and food. The experiments which we have made, and which I did not allude to in my paper, convince me that we have never given aquatic animals, marine animals, certainly, credit for growing one-half as rapidly as they will grow under favorable conditions, and with an abundance of food. There are many marine organisms that you can feed and notice an increase in size on the following day.

Mr. Titcomb: There is a red one here. Is that the color it assumes when it is dying?

Mr. Bumpus: There is a little difference in the color of all the young lobsters; they are red and green. The dead lobsters generally turn red, but very frequently you will have lobsters that live for a long time and are red.

President Peabody: Any further questions?

Mr. Stranahan: If these young lobsters are fed with an abundance of food, you think they undoubtedly get through these various stages much quicker?

Mr. Bumpus: I do; yes, sir.

Mr. Stranahan: The fresh water lobster can be forced to shed in about a week by giving it an abundance of food.

Mr. Bumpus: I am glad to know that.

Mr. Stranahan: I should presume that would likely be true also with these young salt water lobsters.

Mr. Bumpus: We have kept the young star fish to show how rapidly marine animals will grow; we have kept them so that they were less than the size of a head of a pin for some weeks, showing absolutely no increase, although they belonged to the same brood as others which reached a greater length; brother and sister, but one had been well fed and the other had not.

Mr. Bower: How does the hatching percentage compare with the hatching percentage under a strictly natural environment?

Mr. Bumpus: I think it is absolutely impossible to answer that question. How can one tell the number of eggs that hatch from the forty thousand that the female may start out with in July this year and which she carries around with her until next spring under natural conditions? You can not follow the lobster all that time and I do not know what the loss is. They can not be counted. I do not want to avoid your question, but I do not see how you can get data to determine.

Mr. Bower: I did not know but you could tell approximately.

Mr. Bumpus: I think if you could brood the lobsters in the hatchery until they reach this stage when they really are old enough to look out for themselves, I think you would be improving on nature very materially. I think if we get ten per cent of the young and raise them to this stage and put them in the waters along in the east, that in a very few years you would notice a striking difference in the number of lobsters captured.

Mr. Bowers: Did you determine how long the star fish is in a free swimming condition?

Mr. Bumpus: Yes, I think about two weeks—more or less.

Mr. Bowers: Does the lobster ever naturally propagate in ponds or inlets from the sea, or has it altogether to be done in the deep sea?

Mr. Bumpus: I think that wherever you find lobsters you will find lobsters breeding.

Mr. Bowers: I was told last week by a fisherman on a very small pond, that he was positive lobsters deposited their eggs right in the pond, and that they hatched and remained right there.

Mr. Bumpus: The lobster does not deposit the eggs except upon herself. They are attached to the hairs upon the lower part of the abdomen and carried around by her and if those eggs drop off they must unquestionably perish. The female lobster keeps the water lapping back and forth all the time which keeps the eggs aerated.

Mr. Bowers: Do you think it is possible that in this small pond less than a mile long, perhaps half a mile wide, with an inlet from the sea, that lobsters will hatch and propagate there and not leave till they mature?

Mr. Bumpus: I think it is possible they might remain there, but I think it is probable that they would not, for this reason: this spring I had a little pond cleared out at some expense and in that pond we provided a screen, so that we could allow the tide to rush in at a certain time and then slowly run out so that there would not be a strong current—and I found that the young lobsters had a tendency to follow the current. It was practically impossible to keep them in. We had several thousand in this little pond; in a couple of days we could not find any except a few dead ones, and the opening from the pond is very small, still those little lobsters would escape. I know they did because I had a trap outside the pond and caught them.

Mr. Bowers: Is the bottom of this pond all sand?

Mr. Bumpus: It was pretty clean gravel because we made it so.

Mr. Bowers: The pond I refer to abounded in ledges.

President Peabody: Any further discussion of this paper? If not Mr. F. N. Clark, Superintendent of the United States Fish Commission, of Northville, Michigan, will read his paper.

WHAT IS PROTECTION TO FOOD FISHES?

BY FRANK N. CLARK.

The importance of protection to fishes as a source of food supply, and a remunerative outlet for labor, cannot well be overestimated.

The necessity of adopting a proper and effective plan to increase and maintain our most valuable food varieties, is unquestioned, but the false impressions that prevail in the minds of many of our legislators, and the diversity of opinion among public men who are instrumental in the passage of unwise laws, make the work of the fish culturist doubly difficult. The prime object of all Fish Commissions, both State and National, is the perpetuity of fish life which contributes so materially to the welfare of mankind. I am today more impressed with the magnitude and importance of our fisheries than ever before, and the more deeply I study into the question, the more keenly is aroused my appreciation as to the real merit of fish cultural work.

Upon the success of its industries depends the prosperity of a Nation, and while the fishing industry, of itself, is a most important one, its close relation to other industries, and their partial dependence upon its success, is of momentous consideration. Our fisheries are a great source of wealth, giving employment to a vast number of our people, and furnishing the most wholesome nutritious meats for our population of 76,000,000. It is certainly good policy for the people to protect and develop this one of their great sources of affluence.

We are all familiar with the fact that the causes destroying the spawn or fry in their natural beds are increasing, while the demand for fish food in the extended markets is increasing, so improved methods and protected propagation have become not only a National duty, but also an imperative necessity. In connection with the work which we represent, according to my judgment, the most vital question of all is the question of protection. When the question of protection, as applied to all the different varieties, is definitely and accurately settled, in every particular instance, the efficacy of fish culture will have been unanimously accepted, and will have reached a degree of perfection beyond our wildest dreams. And, although, a vast amount of good has been accomplished in behalf of the fisheries by the protection and assistance furnished by our different Fish Commissions, the hearty co-operation of law with fish cultural work is absolutely necessary to complete and perfect the science and art of fish culture. The word "protection" is often a misnomer, and on account of the euphony it carries, and the nutritive and beneficent qualities which it naturally suggests, many laws or methods under this head are passed, relating to our fisheries, and are frequently more oppressive than protective. If laws are so stringent as to prevent fishing for any great length of time during the year, this kind of legislation simply keeps the fish from our nets, our markets, and our tables, and is not protection at all. The object of true protection is to increase and maintain the supply to such an extent that very few laws will be necessary to assist nature and protected propagation to establish an equilibrium, without prohibiting the capture of mature specimens for human use, and thus obviate the imposition of many hardships, and the infringement upon the rights of those whose destined vocation it is to fish for a livelihood, by the retention of valuable food products in the waters, thus, under the shield of the law depriving the people of food which our Creator has so abundantly provided, and which with proper care and husbandry will, in all probability, supply any future demand.

Instead of maintaining the fertility of our soil only to its present productive power, there will come a time when conditions will necessitate that one acre of land must yield ten times, or twenty times, (as the case may be) as much as it does now. Imagine how inadequate would have been the crude facilities of olden times to meet the requirements of our present population! There must be a corresponding improvement upon the methods now employed, with the future increase of population, or their demands can never be supplied. If our population doubles every thirty-three years in the future, as it has in the past, the time is fast approaching when this country will become very densely inhabited, and the same is true of the rest of the earth. At this rate of increase, in only 132 years from now, we shall number, in round numbers, 1,200 million souls—and this is not far in the future—less than four generations of only one-third of a century each, when the population of this United States will be equal to about three-fourths of the present inhabitants of the globe. Pause for a moment and think how insufficient would prove our present stock of fish life to supply the needs of such a population!

And it is sure to come, if the wheels of time continue to move on and the earth is not destroyed.

We shall not be here in person, but we shall be represented by our posterity. The improved methods of preserving fish by cold storage, canning, etc., and the constantly increasing facilities for fish distribution, with increased demand, should stimulate research for improved methods of protection and propagation, and we should and can prepare the way for making the waters furnish the larger supply of meat foods for future emergencies. It has been claimed that nature has made ample and abundant provision for the great waste and loss of eggs which are cast by the improvident female in such reckless profusion and the destruction of fry, by the fecundity of the fish, but a more reasonable, liberal, and rational view to take of the matter is that nature has thus bountifully provided for the constant growth of the human family, who are given dominion over the fishes.

Three-fourths of the earth's surface being water, naturally suggests to my mind that at some future time, the dense population of the globe will necessitate mankind's dependence, to a great extent, upon the fish life of the rivers, lakes and sea, for his support, and it is a duty that we owe succeeding generations that we look that far into the future, when all available land will be required for the cultivation of cereals and fruits, and the non-support of fish life would mean famine. There is hardly any limit to the extent of the supply that our waters are capable of furnishing, with proper care, management, and protection. The system now in vogue is yet almost in its infancy and of comparatively recent trial and application. Who knows but what this great reproductive power possessed by food fishes may have been a provision of nature, to meet the requirements of such a populous condition of the earth which will necessarily prevail, if the forces of nature continue to act in the future as they have in the past, and the progress is not arrested by Divine interference?

When we become as densely populated as China, then we must do as the Chinese do (only with improved and better methods); that is, draw most of our meat from the water.

The Chinese have for a long time bestowed a great deal of attention to fish culture. With them it is a branch of economy. From the extent of their water territory and the enormous quantities of fish that can be cultivated, fish are very cheap, and form not only a most important article of their diet, but also of their National wealth.

Protection to successive generations of fish must necessarily include successful reproduction, and a proper method of protection cannot be decided upon without an accurate knowledge of the characteristics of the fish under consideration. What constitutes protection to one kind of fish may be decidedly detrimental to another. But, this truth some of our law makers do not seem to realize, and indiscriminately pass laws practically similar for different fishes whose habits are as far remote as the nature of man resembles that of some of the lower animals. For instance, the class of protection which would insure the perpetuity of the lake trout and whitefish would be sure extermination to the black bass and to members of the Siluridae family which are bedguarders. The majority of our laws, however, discourage fish cultural operations. Note the imposition and insured waste of a closed season for lake trout and whitefish during their spawning period, making it difficult for the Commissions to procure the ova, and consider the heedless destruction of millions of useful germs which die in the unripe fish taken just before the spawning season. If they are to be protected at all, it should be during the month or months when the largest lifts of unripe fish are made. The laws for the so-called protection of the black bass are equally inconsistent, allowing the fish to be taken from its bed while furnishing such protection to the eggs or fry as nature and instinct have provided as indispensable to the future development of its brood or progeny. Such laws are not "protection to food fishes." With proper legal support, protected propagation is an invention designed to counter-balance the drain upon our stock of food fishes and to sow while man reaps.

Wise fish cultural operations, supported by co-operative law, are necessary for the future maintenance of our fisheries. The harmonious blending of these two is "protection to food fishes."

Statistics seem to indicate a marked increase in the annual catch of some of our most important food fishes the past few years, and I am persuaded to believe that these gratifying results are due more especially to protected propagation than to protective legislation—restricting or regulating the fishing—and that, so far, protective laws have been very ineffectual in restoring and maintaining our stock of food fishes, and that nature, when unassisted and not protected by man, could never establish an equilibrium or begin to counter-balance the drain imposed by our commercial fishermen, even with the accurate enforcement of twice our present number of stringent so-called protective measures. And, to spend large sums of money to prevent the people from fishing is in direct opposition to the purpose for which all Fish Commissions were established, and it is an injustice and a hardship to thousands of fishermen, who with their families, are dependent upon our fisheries for a living; so the kind of protection most humane to the fishermen and most advantageous to the whole people is that which will encourage and develop the industry, instead of closing it, and instead of taxing the people to raise funds to enforce laws depriving thousands of honest men of their occupation, bringing destitution into their homes, and keeping the food from the general public, why not appropriate that money to the establishment of the industry, thus increasing our natural resources and adding materially to our public wealth? The water in the lakes, rivers, and sea belongs to the whole people, and it is the duty of the age that steps should be taken to maintain and develop our fisheries which are now holding their own, and to re-establish those which are now on the decline.

Prudence requires that we should meet the foes and obviate the dangers which threaten our food fishes, by turning all our philosophy, science and art into practical investigation. There are men here in our midst who have added some very valuable discoveries to fish cultural work, and have materially improved upon methods formerly employed which were learned from previous experimenters, and so there will be others who will come on after us, and taking up the work where we drop it; they will substitute in place of our very imperfect methods, some mode of protection which, as the necessity will demand, must insure better results. It is not my desire to present to you any startling facts with which you are not familiar, but I am impressed with the importance of protection, and instead of trying to throw any light on the subject, I am endeavoring to seek information by arousing a discussion on the question, and thus be benefited, myself, and stimulated to renewed thought, and perhaps, indirectly, be the means of doing some good, by suggesting that at our next meeting some of our members (or all of them if they feel so disposed), debate the question of protection more particularly with reference to laws best adapted and required for the success of their particular line of work.

In this way, we could all be benefited. It was my intention at first to compare laws, making use of statistics, by reviewing the results following the various changes in so-called protective legal measures regulating our fisheries, and after procuring a number of old laws, and deducing some comparisons and results, I concluded that the subject is entirely too lengthy and too comprehensive to be taken up in such a light and discussed at this meeting. To corroborate my views as to how ineffectual are the many laws relating to our fisheries, I have taken the time to communicate with some of the chief officials of the different State Fish Commissions and with interested private parties who have repeatedly made applications to have certain "fished out" streams restocked, and I find them almost unanimous in their opinion that where an increase has been noticed, it has resulted almost entirely from plants made, and cannot be attributed to stringent legal measures. The most marked results in the line of very noteworthy success attending protected propagation may be seen in the re-establishment of the shad industries, which a few years ago were on the decline; it will be observed that (with the exception of the removal of obstructions from our rivers, thus allowing the fish to ascend for the purpose of reproduction), protective legal measures regulating the fishing have been practically null and not required to save the shad from almost total extinction and build up the industry to its present proportions—protected propagation with that one necessary law having done the work.

Shad ascending the rivers only for the purpose of reproduction are caught only during their spawning season (practically) and as mature fish, and the young shad, probably three inches in length, which leave the rivers in the late fall or early winter to return to the sea and remain there until maturity, which is from three to five years, are practically beyond man's dominion, and comparatively no immature specimens (or young shad) are wasted by out nets. With fish which are not bed-guarders, I think that an observation of the effect of protected propagation on the shad fisheries is sufficient proof that for such fishes there should be no closed season during the spawning season, for then is the harvest and let us reap, but, of course, save seed for the next sowing. Whitefish not being anadromous, and the young remaining in the lakes the year round, require protection, which our laws do not seem to furnish. More than one-half the whitefish caught are under two pounds' weight, and about one-half of those weigh less than one pound. This is wholesale slaughter, and a sin! A great many more so-called protective statutes have been passed pertaining to the whitefish industry than to the shad, but the increase in the annual catch of the former the past few years has not been so remarkable as in the case of the shad, and the reason to me is very evident.

Protected propagation has done its part in both instances, but bad laws relating to our whitefish industry have, to a great extent, counter-balanced the good effects of fish cultural work, one of the most unwise and destructive features being the denial of proper protection to immature specimens. The laws that assisted man's protection to nature in the recent re-establishment of the shad fisheries have been very few, but entirely co-operative. However, in spite of injudicious licit measures, and the most persistent and destructive methods of fishing for lake trout and whitefish in the Great Lakes, it has been possible to assist nature to such an extent, by the aid of protected propagation, that the annual catch of whitefish in Michigan waters during the fiscal year 1896 was an increase over the previous year by more than 12 per cent, and during the year 1897, the percentage of increase over the preceding year was in excess of 22, making an increase over the year 1895 by a trifle more than 38 per cent.

Taking for my guide, the fluctuating condition of some of our very important fisheries in years past, with reference to their alternating periods of depreciation and enhancement, I have made some study of the laws which pertained thereto, by noting the results of various changes in so-called protective legal measures, and I am firmly convinced that a few wise laws, and their rigid enforcement, are just as essential to the future development of our fishing industries, as is fish cultural work itself. We have had some good laws passed for the protection of the young whitefish, and also the immature specimens of lake trout, but owing to defects and loopholes in these laws but little has been accomplished in the way of enforcing them, and up to within three years ago there was practically no enforcement of law at all for the protection of immature fish in the Great Lakes. To me, this subject of protection is the trunk of which all other fish cultural questions are but branches. The plan may never be perfected, even by succeeding generations, but necessity will demand a more thorough understanding of the question of protection; and present conditions, with the future outlook, seem to assure me that the coming sages of political economy will engage their minds in the solution of the problem, and the art and science of fish culture will eventually become a part of the curriculum in our Agricultural Colleges. Fish culture has reached that stage of perfection where billions of fish can easily be hatched, but the more important questions which now confront us are, how can they be subsisted, protected and made to grow? Millions and millions of acres of productive water lie waiting to be converted into fish farms.

It does seem a great step from this plane of perfection to the next higher level, but these are the questions which address themselves most gravely to the student of modern fish culture.

Our Creator, in forming this earth, bequeathed a far greater portion to fish kind than to mankind, and plenteously stocked the waters with fish life upon which man has partially depended for his meat diet since the time of Peter, the Disciple and Fisherman.

Now, is it not an alarming condition that as man's small allotment of the earth's surface becomes more and more crowded, the fish life in the public waters is gradually declining? There are many fishes whose habits and characteristics are too indefinitely known to properly apply protective methods, and with these instances a gradual decline of the industry is a natural result. It is claimed that at the present rate of decrease, the oyster, which is of such great intrinsic value to our people, will become practically extinct within the next ten or twelve years. The public waters cannot be conveniently utilized in the establishment of cities, but with proper assistance and protection to nature, they are admirably adapted to furnishing all cities with an abundance of fish diet. If proper remunerative encouragement were offered by our Government for the insured establishment of a successful plan to repeople the public waters with valuable food fishes, thus making food cheaper, affording a remunerative outlet for labor, building up a National industry, increasing our public wealth, encouraging the advancement of science and art, and finally to more than re-imburse our public treasury by increased revenue from our fisheries, in years to come, it is my belief that many of the best talented minds in our country would set to work to accomplish the desired aim.

It would be capital well invested, and if the acquired results were not quite so perfect as anticipated, the money would still be expended in a profitable and commendable manner, and it would pave the way for future accomplishments in this line. Within the next fifty years, there may be as great a revolution in the introduction and employment of new protective methods as there has been the past fifty years in the application of electricity. The achievements in electrical science seem to have been realized out of nothing to begin with. The germ has to be detracted from the elements, then bottled—so to speak—before it can be made to manifest itself as useful energy employed as man's servant to be used at his will; but with the fish germ, it is different. We can locate it without difficulty; it does not have to be manufactured or separated from atmospheric phenomena by means of complicated machinery. We have passed that stage of investigation where the germs in countless numbers can be called into life, and we now seek a class of protection which will insure the maturity of the living germs.

It will be noticed that even so far as my own special line of work is concerned, I have not attempted to discuss this question of "What is protection to food fishes?" although, I feel that, with one or two exceptions, I am prepared to name the class of protection most applicable to the different fishes propagated at the Stations under my charge. My prime object has been to impress upon you the importance of the question which I have selected, and ask that you take up its discussion at our next meeting as it pertains to your respective lines of work, and thus give the rest of us the benefit of your experience. Therefore, I recommend that this Society urge upon its members the necessity of a more comprehensive study of this subject, and that this question of "protection" be taken up in its different phases and at our next meeting as many papers as can be prepared on this topic, be read before the Society and discussed by the members.

DISCUSSION OF MR. CLARK'S PAPER.

Mr. Gunckel: Mr. Chairman, that is the great question which has been agitating the Fish Commissioners for the past fifteen or twenty years in the State of Ohio. Whenever they seem to get a law that is right for the protection of the fish, the commercial man, backed by wealth, will go to Columbus and so impress upon the various committees the importance of changing the laws to suit his manner and way of thinking that no law ever has been introduced yet that has proven successful. Today on the reefs of Lake Erie we have a new invention called the trap, which is absolutely destroying the black bass. I presume most of you have noticed recently Ex-President Cleveland's trip to Middle Bass, in an article in one of the Eastern papers, where he pronounces it as an absolute shame that the United States did not take this matter up, and that the fresh water lakes, particularly Lake Erie, should be protected similarly to the way Canada protects her half of Lake Erie. When I went down to Columbus and told these Fish Commissioners that something ought to be done, they say that they have this to meet, that while they will do something which looks right and proper for the protection of the fish, Michigan, New York, Pennsylvania, bordering on Lake Erie, will have different laws, so that they conflict, and while in Ohio we are not allowed to fish beyond the 10th day of June, Michigan will fish and take the fish that would naturally run into the waters of Ohio. So it looks to me as if we must fall back to the distinguished and sensible representatives of the United States. I do not see any other way. After hearing the able and very interesting article which has been read, how they can produce fish here almost by charm, I think they can do most anything. I think it is a subject if it was introduced at our next meeting that would, if the gentlemen from the northwest were brought here, occupy the entire time. I do not think we can ever accomplish anything except to appeal to the United States. I would like to hear from Mr. Stranahan on that subject.

Mr. Stranahan: Mr. Chairman, I believe, so far as we know, all the United States Court decisions have been to the effect that the United States has no authority over those waters. There have been a number of decisions, and I believe all have been in that direction. Mr. Ravenel is better acquainted with that matter and with the law than I am .

Mr. Ravenel: It is simply a matter of guess as far as I am concerned, but we have always understood and I think the State Courts have been sustained by the United States Courts, that the jurisdiction of the Great Lakes rests entirely with the states bordering on the lakes. In Canada it is entirely different. In our country each state passes its own laws and enforces them and the United States has no jurisdiction whatever over inland waters or lakes.

Mr. Titcomb: I would like to inquire if there has anything been done towards the states ceding their rights to the United States? If these states bordering on the Great Lakes should cede their rights or their jurisdiction over the fish of those waters, would it not then be possible for the United States to enact proper protective laws which would be uniform?

Mr. Bowers: It would necessitate an act of Congress.

Mr. Titcomb: I understand if every state should cede the control of these waters, then the United States, through Congress, could enact laws protecting the fish.

Mr. Ravenel: I know that at present we have no jurisdiction.

Secretary Whitaker: I believe this matter was brought up in the Supreme Court of the United States many years ago and the first decision was rendered by Chief Justice Washington, and uniformly from then down to Chief Justice Waite, whenever the United States Supreme Court has been called upon to pass upon this question its decision has been that the power of police regulation under the constitution as it was adopted was reserved to the individual states, and that the United States Government could not exercise it. That is the condition of the law, and it has been the decision of every court of inferior and superior jurisdiction in this country. I think that may be said to be true without any sort of qualification.

Mr. Ravenel: It would require a constitutional amendment, would it not?

Secretary Whitaker: It would require a constitutional amendment, an agreement to it by the states. I would say in that connection that last fall I was invited to appear before the High Joint Commission at Quebec on this very question, and I took occasion to say certain things to them upon the matter, and very likely that will be one of the questions that Commission will decide, if they ever decide anything, in the near future.

Mr. President, and gentlemen of the Society: I desire to say something upon the paper that has been read by Mr. Clark. A twenty years' connection with the fisheries of the Great Lakes has given me some familiarity with the subject, and the facts so far as they exist will bear out the statements I shall make.

Something over thirty years ago the United States Government, in considering the interests of the people in the fisheries, decided that the propagation and the protection of commercial fish and the causes of their decay, were subjects which warranted the government in instituting an inquiry. That inquiry was made, and as a result the United States Fish Commission, eventually, came into existence. Following that the different states of the Union, to a very great extent, appointed commissions whose purpose it has been, as it has been that of the United States Commission, to propagate fish, and to recommend such laws as would subserve the public interest in the protection of the fisheries.

The question of protection of the fisheries is not a new one. It is one of very grave importance. It has challenged the attention of the people from time to time ever since I have known anything about the commercial fisheries of the lakes. Various bodies have met together from time to time that were representative of the fish commissions, and of the commercial fisherman, to consider and settle this question, if possible; but I say, without any fear of contradiction whatever, that today, on the Great Lakes, notwithstanding all these inquiries, we are practically without laws for the protection of fish.

In 1892 this question was thought to be of sufficient significance by the Canadian Government, to open a correspondence with the State Department at Washington, suggesting a joint commission to inquire into the causes which had brought about the present condition of the fisheries. After the usual routine that is necessary between officials, there was eventually appointed a representative on the part of the United States, an expert by the name of Richard Rathbun; and a gentleman named Dr. Wakeham representing the Canadian Government. Those gentlemen made a very thorough examination into the present conditions and the past history of the fisheries of the Great Lakes, and the things that should be done to protect them, and they joined in a report to their governments which has now been before the public since 1896.

The condition of affairs on the Great Lakes has been this; that with the exception of a brief space of time during which the harbors of the Great Lakes are closed by ice, there has been no protection to the fish. Laws have been passed from time to time in my own state regulating the meshes of nets.

These, through the insistence of the commercial fishermen, have been repealed, and today I say, without fear of contradiction, that the fish are practically without protection on the Great Lakes. Each state claims that the other does not protect according to its notions; and that there are differences that ought to be reconciled, but up to the present time there has been no reconciliation of differences. I do not entirely agree with this view of the matter. I believe on the same theory a state might complain that it could not fix the legal rate of interest at five per cent because a neighboring state fixed it at three, and that therefore, there should be no legal rate of interest established. It is the state's first duty to protect itself, and that is what the state should be expected to do.

There are two great movements of fish in the lakes; to the deep water for feeding, to the shoal water for spawning. Those movements are as well known and as well recognized, and always have been by the fishermen as by the fish themselves. The mesh of gill nets in 1840 on the lakes, and to about 1866, was five and a fraction inches, to six inches, differing in different localities. The meshes of other nets were correspondingly large. They did not need to be smaller because the fish were large enough. There was then no market except for such fish as were caught in the fall of the year. But the country grew, and today we have in the six states bordering upon the Great Lakes one-fifth of the population of this country, saying nothing about the great population that we furnish with fish beyond this territory. Then freezers were built, and it was possible to take the glut of a season and preserve it for the market for an entire year to be marketed in addition to what was taken in the season following. The fish are fished for during the summer months, and they are fished for during the fall. As the fish began to decline in size the nets gradually began to contract until they were finally reduced to the present size. A very good illustration can be cited of the value of good laws in protecting the fisheries, on our boundary waters. The National boundary of the great lakes extends through Lakes Huron, Erie, Ontario and Superior. Lake Michigan, lying wholly within the jurisdiction of the State of Michigan, is today, with the exception of trout, practically barren of its best commercial fish. The white fish industry has come to be of little importance on that lake. But on those waters on the international boundary the Canadian Government has for years established a closed season for fish in the month of November, which it recognizes to be the spawning month. It has regulations that provide that trap nets shall not be set beyond a certain number of cribs in a string and provides that there shall be certain gaps between strings of nets. It imposes a license upon those who enjoy the benefits of the fisheries; and my opinion is that Lake Huron, Lake Erie, Lake Ontario and Lake Superior would be in the same condition as Lake Michigan if it were not for the fact that one-half of the waters of those lakes are protected by law. For years the Canadian Government has sought co-operation from the states adjoining their boundary so that laws might be passed that would agree with their own and give the needed protection, and two years ago Michigan proposed laws to protect the fisheries during the spawning season.

Let me here say that there is pretty good authority as to the necessity for a close season, furnished by the official report of the United States expert above referred to that may be properly referred to in this connection. I have not had time for the preparation of a paper, but there are some things that I would like to call attention to in this report which I have here, which seem to me to verify and carry out the idea that the fisheries do need protection and need it badly, and that the closed season is one of the things to be recommended. (The speaker here read quotations from the report referred to.) Now, there is no difficulty whatever in a state passing a law if it chooses, making a closed season, such as these gentlemen recommend, and which has been recommended or favored as far as I know, by most every meeting that has been held to consider the protection of fisheries. If such laws are passed by a state, it does not necessarily follow that because a closed season is fixed, fish-culturists cannot secure the ova of fish with which to carry on artificial propagation. Power is possessed on the part of the states to pass such an act as is now upon the statute book of Michigan, permitting their Boards of Fish Commissioners to take fish for purposes of artificial propagation at any and all seasons of the year when necessary. So there is no argument in the claim that because a state imposes a close season for the protection of fish in their spawning season, the work of artificial propagation must cease. The trouble has been heretofore that the tendency of legislation respecting the fisheries has been towards a protection of fishermen in a right to fish at all times of the year, and not to a protection of the fish. When you take an industry which you pursue ruthlessly from one end of the year to another, without restriction as to size of mesh, without restriction as to size of fish, without restriction as to fishing on spawning beds, you will find that what has happened will always happen. We find the whitefish catch declined in Michigan from eight million pounds in 1885 to three and a half million pounds five years later. Now, where are you going to get your whitefish, with this continuing decrease? Where are you going to get your parent fish to breed from in a few years? What is the present condition of Lake Ontario, which the United States is attempting to restore? They can not find whitefish enough in Lake Ontario with which to stock their hatcheries at Cape Vincent on that lake.

A comparison is instituted in the paper between shad and whitefish, but that argument is faulty. Notwithstanding the Great Lakes are, as it would seem, almost illimitable in their extent, they are indeed restricted areas which can be surrounded and are surrounded by nets on every side. They are fished from one year's end to another; in season and out of season; in the summer; in the fall and in the spring, and so far as possible, in the winter. On the other hand, as Mr. Clark has said in his paper, the shad is an anadromous fish. God Almighty protects that fish about eight months in the year because it goes out into the ocean where the nets cannot reach it. It does not need the legal protection that fish do in the restricted areas of these lakes. The consensus of opinion of this body has been, and it has been so expressed within three years, that a greater protection to fish should be given. It has recognized the necessity of protection. Everybody recognizes it. It appeals to good judgment. It must be done if you are going to keep your fisheries.

We have had this question of a close season up in Michigan, and the attempt was made to repeal the measure at this session of the Legislature, but it was not accomplished. The attempt was defeated in the Senate although it passed the House.

We have an organization in Michigan called the "Michigan's Fisherman's Association," I believe—alias the Michigan Fish Trust. It has been fighting with people whom they call the Chicago Fish Trust. This Chicago Fish Trust appeared there, so far as my information goes, as an advocate in favor of sustaining the closed season. The Michigan Fish Trust said, "They want to keep up the market prices of fish." So far as these organizations are concerned, I care nothing for them; but if either trust is to be trusted the Chicago Fish Trust is the safest one.

Now, let us see what this Michigan's Fisherman's Association, otherwise properly denominated the Michigan Fish Trust, has done in Michigan in the last ten or fifteen years. Two years ago the Michigan Commission succeeded in getting one bill passed. We presented three bills; one in accordance with the suggestions made in this government report I have referred to, that if you are going to control and regulate fishermen you must license them. They defeated that bill easily. Another thing we proposed was the enlargement of the meshes of the nets, and the other was for a close season of November. These matters were all discussed in our Board and agreed upon beforehand, the majority disagreeing with the proposition that the gill nets should be four inches. They thought they ought to be five or more. I agreed with them, but suggested that we should take what we could get; that if we could get them to open the mesh a little we would see if we could not get them in time to open it further, and I opposed putting in a bill that would be defeated because of the extreme size of the mesh asked for. That law was passed fixing the mesh at four inches, and it has stood on the statute book for two years. But what has occurred this year? But I am anticipating, and I want to say before I go to that, that the Michigan Fish Trust has been all these years claiming to us: "For God's sake do not put your regulation on the twine, you are doing away with millions of property; you are practically confiscating it." So a provision was put in allowing three years to fish out the twine. That was certainly long enough. They have always met every proposition the Michigan Commission has made in the way of protecting fish by saying that the only way you can do it is to fix a regulation as to the minimum size of fish that may be caught. They said that the whole matter could thus be regulated and that they would favor such a law. The answer to that, of course, is apparent to every one. You would have to have a warden at every net to watch and see what they were doing. But without any interference whatever these people went to the Legislature this year and passed a law prescribing a limit of size of fish; for whitefish two pounds, and a limit for other fish at other sizes. Then they went to work and in the closing days of the session reduced the size of the mesh to three and one-half inches; and to cap the climax, almost on the last day of the session, the Legislature, at the instance of the Michigan Fish Trust, passed a bill legalizing the sale of fish of any size caught in any legal sized net. Now, what was the result? I discovered that provision a week ago last Saturday, and wrote to the Governor calling his attention to the facts and he vetoed the bill.

Now, if you are going to give protection to fish at all, and you must give them some protection, here is a pretty good thing to call your attention to as to its necessity. The Pribylov group of islands lies off the peninsula of Alaska. Within a certain hour of a certain day of almost every year, the fur bearing seal, through the instinct of nature, comes there to reproduce its kind. It is their spawning season, their calving season. The United States Government has been attempting for a number of years to regulate that fishery, to save the seals; and the decay has resulted notwithstanding that, the only time they are fished for is in the season when they propagate.

Now, if you are going to give any force and effect to this work of propagation you have got to act honestly in it. It is not the province of a commission to do anything but its whole duty. Let us not magnify the importance of our office, nor be swallowed up with the idea alone that we are Commissioners. Let us thoroughly appreciate that we are public officers charged with a public duty, and that we must not temporize with people who are attempting to destroy their own privileges. Let us act faithfully and honestly. That is our work. That is the moral side of it. If you want to take the other side, take it. Does it pay? Michigan has put into its waters since the Commission was established one thousand million whitefish. One billion. The United States Commission in the same time has probably put in a quarter more—perhaps I am understating it. But those are large figures, and what is the result? Our whitefish fisheries had fallen from eight millions—and no one knows how much more, because those were the figures when we first took statistics in 1890—to three millions. The statement is made that these fisheries have increased within the last two years. Nobody can really tell that, for this reason, that it has not been taken for the last two years; it is being taken now for the last of the two years mentioned. We get our statistics by going to the fishermen and asking them what their catch is. What is the situation, and what is the animus that has controlled these fishermen? Two years ago a close season law was passed. They got out an injunction against the warden to restrain him from enforcing the law. It was a most novel proceeding, and the judge who enjoined him was reprimanded, on appeal, by the Supreme Court, for having proceeded in that way. But that is the course they took and they succeeded in staving off matters, for practically the whole season. They intended to come to the Legislature last year to abolish that law, and they had to come well fortified, and they came there claiming an increase in the last two years. From an examination I made of the statistics I found, I think, there were only two varieties that showed an increase. One was herring and the other was whitefish. I took one small district, and the figures showing increase of whitefish were astounding; the first time it had shown an increase since we have known anything about it. These figures are open to challenge the same as are the facts in a case before a jury. Now, do we care nothing for this condition of things? The fact is, your fisheries are going. You have got to have some practical way in which you can bring about protection. You cannot restore the stock by propagating fish alone. I know as well as any one how effective that work is. I am not disputing that proposition. You can do better in the way of artificial propagation and distribution than by allowing "Nature to take its course." Yet notwithstanding all the efficacy there is in modern fish culture, you cannot perform a miracle with it. The idea that you must protect animals at certain seasons of the year is recognized all over the earth.

But I misspoke myself when I said that we had no protective laws in Michigan. We have indeed. Two years ago a man from one of the fishing districts of the State which has been most violent in its opposition to laws protecting fish, presented and had passed a bill to protect muskrats! And a bill was introduced at the last session to protect mourning doves! I do not know whether it passed or not. Wapiti are protected by Michigan laws, but not one man out of ten dozen in Michigan knows what the devil a wapiti is. (Laughter.) There has not been one seen there since the flood, nevertheless, they are protected. The State looks after muskrats, mourning doves, and wapiti with the utmost solicitude. The Michigan Legislature adjourned recently, and the most arrantly partisan republican paper we have in the City of Detroit lambasted that Legislature for its inefficiency and for other things, although it was of their political faith, and said that it was "no good." It reminds me of a story I will tell you: Several years ago a man named Neasmith was elected senator from Oregon by one vote. His friends began to inquire of him about it, and to address him in this fashion: "Now, Neasmith, you are a good fellow, but we wish you would tell us how the deuce you got that vote?" Of course, life began to be a burden to Neasmith after a time, but finally he went to Washington to take his seat. Not having that close and intimate acquaintance with the senators in Washington that he had at home, when they began questioning him in Washington on the subject he could not say to them what he felt. But finally in the course of time he was relieved, and so was everybody—the Senate adjourned, and he went home to his constituents. One of the first men he met on his return was the governor of Oregon, and what he said to the governor may well be said of the Legislature of Michigan—although I do not challenge the Legislature of Michigan to the extent my words might seem to imply, for there were good men there although the other fellows preponderated. Now let me tell the balance of the story. He met the governor, who said, "Ah, Neasmith; back?" "Yes Governor, just came back." "Well, Neasmith, what is the news in Washington?" "Oh, everything is going on nicely down there." "Neasmith," said the governor, "there is a question I want to ask you. You were elected senator from Oregon, but you were only elected by one vote; now where did you get it?" "Well, Governor," said Neasmith, "come here, I do not mind telling you," and he took him by the lapel of the coat and led him off into a corner; "this is the situation of things," said Neasmith, "the night before the vote was taken I needed one vote and I needed it badly. There was one man in the Legislature whom I thought I could persuade to help me out. I got him up to my room, seated in a chair, gave him a good drink of whisky and a cigar, and I said to him; now see here, Jones. I want to be United States Senator from Oregon. I want one vote. How much will you take? 'By gosh,' he says, 'that's the kind of man I like to hear talk. You talk business; you're all right. What will you give?' 'Well,' I said, 'how would one hundred and fifty strike you?' 'One hundred and fifty hells,' said Jones, 'I paid the Governor of Oregon three hundred dollars for pardoning me out of prison.'" (Laughter.)

Gentlemen, I could not let this matter pass without some suggestion on my part of the facts as I have known them. I could have very much better presented this matter in a paper, but I have not had time to prepare it. My life is busy; therefore with these few remarks I will conclude what I have had to say on this subject.

Mr. Clark: The gentleman's remarks so far as my paper is concerned are wholly unwarranted.

Secretary Whitaker: In what respect?

Mr. Clark: Simply because my paper does not touch on the protection of the fish of the Great Lakes alone; it is more general—touching on the protection of fish everywhere. My paper is broader in scope. I only mentioned the fact of the closed season for whitefish, and what laws we do not have about the black bass, just to compare spawning habits of the two kinds of fish. In this whole matter I am not concerned about the fishermen one way or the other, and have not had that idea in my head at all. I was simply looking upon the question as a practical fish culturist, and I have closely observed the work on the Great Lakes and elsewhere for thirty years. That is what has brought out everything upon this subject of protection. There are a few things I would like to answer in Mr. Whitaker's remarks, as long as he has touched on this subject. I want the gentlemen to understand that my article was in reference to the question of protection throughout the whole United States; not confined to the protection of lake trout or whitefish alone—but to everything, everywhere—a different kind of protection, as I said in my paper for different kinds of fish, according to the conditions. The characteristics of the fish must be studied in all matters by our scientists, and especially as to the protection of the food. I think the food question has as much to do with their perpetuation as anything in the world. We must have protection for their food, which is being destroyed all the time, in the lake and rivers and everywhere. By what? By the sewage of the cities for one thing. I think the time will come when our scientists will recognize that fact, and I do not know but they have already. Mr. Whitaker made some statement in regard to Lake Michigan being depleted of whitefish, and Lake Huron and Lake Erie being on the increase.

Mr. Whitaker: No, I did not say Lake Erie, or Huron or Superior were on the increase, or even holding their own. I said they were better than Lake Michigan because they had the protection afforded by good protective laws on the Canadian side of the boundary.

Mr. Clark: The closed season?

Mr. Whitaker: Yes, the closed season, and not only that, but the regulation of the distance the nets should be set apart, the number that should be set in a string and the size of the meshes.

Mr. Clark: In those lakes, beyond Lake Erie, we have something else that has not been taken into consideration, showing why the fishing is better in Lake Erie, and it is conceded, I think, that the fishing is better in Lake Erie than in any of the other lakes, for whitefish especially. As Mr. Whitaker says, during the years since the organization of the Michigan Fish Commission and the United States Commission the total plant is represented by a thousand million, or something like that. The actual figures are one and a half billion, and of that number five hundred and fourteen million went into Lake Erie and the balance into the other lakes. One third of all the fish that have been hatched by the Michigan Fish Commission and by the United States Commission have gone into Lake Erie waters.

Mr. Whitaker: But the balance has gone into the other lakes.

Mr. Clark: Have been scattered in Lakes Michigan, Huron, St. Clair and Superior; Huron getting the most of those fish, Michigan next, and Superior next. That is one of the reasons, in my judgment, why Lake Erie is so much better than the other lakes; from that and not from the closed season. Again, we have another thing Mr. Whitaker brought up; he rather criticised the figures I gave in regard to the increase in fish. Now, where I say "it has been possible to assist nature to such an extent," etc., Mr. Whitaker rather questioned that data. Allow me to state that I took it right from your statistical agent's report.

Mr. Whitaker: I do not criticise the correctness of your figures. I criticise the conditions under which they were taken and the temptation that there was to the fishermen, in view of the fact that a time was coming when they wanted to try to repeal the law, to change those figures and make them larger than they ought to be.

Mr. Clark: The figures go back to 1895, 1896 and 1897.

Mr. Whitaker: I do not know about 1896, of course.

Mr. Clark: I wanted to make known where I got my figures, so that it shows that they are on the increase. The figures show that the fish are on the increase, if those statistical figures are good for anything, and I suppose they are. They ought to be as good as any data.

Mr. Whitaker: They are as good as we are able to get.

Mr. Clark: They are as good as we can get. Now, Mr. President and gentlemen, the idea I have has nothing to do with the fishing. It is not my aim to protect the fishermen there. I simply want more fish in the waters. The fish culturists of the United States have accomplished one thing, and that is that they can hatch fish by the billions. We have gone by that. That is all fixed; and we must now do something more. We shall have to grow those fish. And why do we not do it? I take the ground that the class of fish that do not take care of their eggs are a class we should hatch, because there is such a waste. I can show you by an article I have here, delivered before the Legislature, concerning whitefish penned by Mr. Stranahan at Monroe, that we actually did get about ninety million eggs, and I figured out that we hatched at least sixty per cent, or about sixty million, and there is not a fish culturist in the country that I have ever found who does not say that I am too high when I allow one and one-half million if they were spawned naturally. We put sixty million in the water against one and one-half million by the natural process. Whitefish do not take care of their eggs. They spawn indiscriminately in the water. The female will throw her eggs when there is not a male anywhere near her. That is the idea. Black bass do not do anything of the kind. They can beat the artificial method. We can not begin to come up to them in artificial work. So this is the ground I take—that the kinds of fish that are free spawners and spawn indiscriminately, such as the whitefish, should be taken care of by the protective methods. That was the idea of my paper, but my article was broad and I did not intend to touch on any particular section or kind of fish. The question was upon the subject of protection in all its phases, and what I really wish the Society would do next year is to bring in their different ideas of protective methods for different fish. This idea of a closed season—why, we want the fish. That is what they are there in the water for. Another thing, if you take those large fish out of the water, you leave the food for the growing generations that are coming on. The other day I caught a rainbow trout, I hooked the fish for a Presbyterian minister and let him land it; he was so anxious to catch one. It was just below the hatchery in a little stream. It weighed at least a pound and a quarter, or a pound and a half, and was a nice large rainbow trout. I opened the trout and took out its stomach and carefully examined it. I took eleven little fish out of that rainbow trout's stomach, those being a portion of the undigested contents, and everyone of them was either a brook trout or a rainbow trout, and there was a mass there that looked as if they were fish that might have been hundreds in number. Now, that rainbow trout should have been out of the way, because it was destroying the generations that were coming on. That is the idea, to get the larger fish out of the way. We want them to catch and to eat and to have them out of the way. A great many other things Mr. Whitaker said, I might discuss, but I shall not do so at this time.

Mr. Preston: There were some of the matters in Mr. Whitaker's address I desire to reply to briefly. Two years ago when this question of a closed season came up I as a member of that Legislature used my best efforts to help get the measure enacted, for a closed season for Michigan, for whitefish and trout in the Great Lakes. That measure was enacted into law and the result was that the wealthier fishermen, the large fishermen, formed themselves into a trust. They had capital enough to buy and use the appliances for freezing. They caught just as many fish only they caught them earlier They closed up during the closed season and the consumers of fish, we who bought them, ate just the same fish as we would have eaten only the fish were not quite so fresh and we had to pay more for them. That was all that was accomplished by that closed season legislation. As a matter of fact the smaller fishermen became practically a class of law breakers or attempted law breakers. The State of Michigan, by spending a large amount of money for game wardens and deputy game wardens to control the waters, succeeded in a reasonable measure in keeping the fishermen within the bounds of the law, but it was only by the expenditure of much money for salaries and expenses for the game wardens. If the same amount of money that had been spent for this purpose had been devoted to the Fish Commission for re-establishing the whitefish a great deal more could have been accomplished than was done by creating the closed season. I am of the opinion that the true policy for any state or for the Government is to make liberal appropriation in the way of propagating fish and raising the young fry doing everything to keep them from being killed off, studying their habits and the diseases that annihilate them and doing all that can be done towards keeping the waters stocked. Then, if the people want to catch them let them go ahead and do it.

Mr. Dickerson: Mr. Chairman, I am not going to discuss this question, but I want to say, that until the Fish Commission was organized, A. Booth & Company fought against a closed season. There are many letters on file in which they agitated that question. They were not converted until they had organized a trust and got control of the fisheries on Lake Winnepeg. During the agitation in the Legislature this winter a Canadian who has been in the fishing business all his life, reading the papers and taking an interest in the subject, sent a long communication to us in which he goes on to show, that notwithstanding the protection which has been given in every way in Canadian waters, that the supply of fish had decreased by a much greater percentage in those waters than in our own. I think it a very wise thing to agitate this question, to bring up all the points we can in reference to it, and to make it a special study and subject of discussion at our next session. I desire to offer this paper in order that it may be printed among our papers. I am sorry I haven't it here that I might read it at this time. It is something that will be instructive and will give us the facts and statistics as he has compiled them. It shows conclusively that the decrease is much greater in the Canadian waters, notwithstanding their so-called protection, than in our own. The paper will be of interest to every man who has made a study of these questions and for that reason I desire to ask permission that it be printed in our report.

President Peabody: I would like to ask if that depletion might not be largely due to the continuous exhaustion upon the other side?

Mr. Dickerson: Do you mean by our waters being depleted?

President Peabody: Yes.

Mr. Dickerson: No, theirs are depleted faster than ours. This goes back for twenty years, and shows a much greater percentage of decrease in Canadian waters than our own. I think it would be a valuable thing to have the paper printed in the report, and I offer it for that purpose.

Mr. Whitaker: Mr. Chairman, I have some statistics I would like to introduce in connection with that very question, and in connection with my remarks here, and I would ask leave to do so, because I do not want to tamper with the record after it has been made.

Mr. Stranahan: I would like to ask Mr. Whitaker how he would supply hatcheries with whitefish eggs or cisco eggs, or herring or lake trout for the closed season in November, in any place except the Detroit river. For instance, our hatcheries at Put-in-Bay; how would he supply it with eggs with a closed season in November?

Mr. Whitaker: I am glad that point has been raised, because there is something in connection with it that I had intended to say. When the question is mooted as to the enlargement of whitefish work on the lake, I want to say that on the facts we had reached that limit, practically before that law was passed. We have attempted in Michigan waters to supplement the work on the Detroit River by taking spawn elsewhere, but found we had practically reached the limit of what we could get. Now, to answer the question directly I will say this. All good law means the greatest good to the greatest number. I do not agree at all with the remarks that have been made by my friend, that it is the business of the Fish Commission to let these men, if they want to, fish out these waters, and that it is their interests more than any other that wants to be subserved, and it is they who are suffering more than anybody else. I cannot agree with him, because the real question is: Can we, as Commissions, maintain under proper regulations a great food supply that practically grows in the water without care or cost to the public, as interested in this question as anybody else. The fisherman is directly interested in it because of the amount he gets from the industry, but after all this is the great question, how can we preserve the fisheries and stop the waste, and no commission lives up to its possibilities which does not consider it, and all other questions are incidental to this. Here is a great food product that should be maintained, and the people of this country are more interested in that question than all fishermen on earth can be. It is a question of maintaining a cheap food for the people. It is a food that grows without the hand of man from the time it is put in until it comes to maturity. I tell you this is a great public question, and no set of men, whether it be a fish trust or the fishermen, have any right to prejudice the interests of the public in a source of food supply because of their own selfishness.

So far as this particular question of Mr. Stranahan's is concerned, I will say that it is within the province of every legislature to grant just the thing you desire and just the thing we all desire, the right to Commissions to fish for seed in spawning time. We have such a law in Michigan today. It was not because we could not fish in the closed season that we stopped, but it was because the fishermen had power and strength enough to go to the Legislature and say they would punish the Fish Commission for presuming to hamper them by any sort of law, by cutting the appropriation, and they did it. It was not because we did not have the law by which we could act; it was because these men sought to hamper us in this way, as a rebuke to Commissioners who draw no money for work, who want none, and who have worked faithfully in the interests of the State. Yet they characterize us as men who have a selfish interest. We have nothing but the interests of the public at heart. This thing that you speak of can be taken care of. You can get your eggs as can every other Commission, by a law passed permitting you to get them during the closed season; of course, with proper restrictions. I would go a step further than has been done in Michigan. The law ought to be, and the United States Commission can do now, what we have never been able to do, return every stripped fish that was in good condition and likely to live to the waters, and not market it. We have been forced to market fish because of the small appropriations we got from time to time.

Mr. Clark: Mr. Chairman, there is one point there it does not seem to me the people grasp. It is not the idea of how to run our hatcheries. If the closed season is the right thing, if natural spawning is the right thing, the artificial or protective propagation is wrong. They cannot both be right. If the process of a closed season, allowing the fish to spawn themselves, is the right method, then the other is wrong, and I do not think the point is well taken as to how we are going to run the hatcheries; that is not the question at all. The question is how you can save and return the most fish to the waters. That is the question. It is not by their spawning naturally, for nobody for a moment would think that you could put in as many as you could if they were protected. You simply get the eggs and protect them until they come to a certain stage. It looks to me like saving those eggs. They are wasted, all but a fractional percentage of the whitefish, if they spawn naturally, but if you have those eggs and protect them and take care of them and plant them in the water you plant a moving, living thing, but if they spawn in masses as they do sometimes, it is simply a wholesale waste. The time to protect your adult fish, the time to make your closed season, is when the most unripe fish are caught, because every unripe whitefish that is caught means thirty to seventy-five thousand germs wasted.

Mr. Whitaker: May I just say a word further? The point of it is this, you can fill this country with Fish Commissions, put them on every square mile of land, and it is not possible for you to spawn all whitefish that are taken in the month of November. The point is take all you can, but do not let the fishermen kill the ova in the rest. This small precentage under natural spawning that is spoken of would be saved, and that would be an advantage of a close season, but as the United States expert said in that report I referred to we must make some regulation, you must regulate the fisheries in some way, and you must restrict the catch. They say it in those plain words. If you are going to do that I do not know of any better season to establish those restrictions than during the spawning season. Put the ova into your hatcheries, hatch all you can, but do not let a man take those fish that will spawn in the natural way, even though only a small per cent are hatched, and destroy them and market them.

Mr. Preston: What difference will it make whether those fish are protected in November? Suppose those same fish are caught during the month of October. They have all those germs in them and they are killed just the same, and what difference is it going to make if you have a closed season in November, but have allowed these wealthy fishermen to catch these same fish in October and put them in freezers and sell them to us in November when they are not quite so fresh and when they can make a little more money out of us. They have killed the spawn to just the same extent.

Mr. Whitaker: There has never been a proposition to make a closed season at any other time in the year, and no state would pass such a law.

Mr. Preston: But, as a matter of fact, it is true that we have made a closed season in the month of November in Michigan and the fish are caught and put in freezers in October, and the fish are filled with spawn at the time they are caught.

Mr. Dickerson: I want to explain why the trust fought so strenuously on the question of the closed season this year. They control the whitefishing of Lake Winnipeg. Twelve hundred tons of whitefish were caught in Winnipeg last year. Nature makes a closed season there in November. They can not catch any fish then and do not want anybody else to. Now, if we have a closed season they have no competition with the smaller fishermen down in our lakes where nature has not made a closed season, and for that reason our fish are put into the market and the product diminished. If we have an open season they would have the competition of all the small fishermen. With the closed season the trust could absolutely control everything. But that is the reason Booth & Company always favored an open season (until the trust was organized), and the Michigan Fish Commission's office is full of letters from Booth & Company on that subject. They now come in and say: "Gentlemen, we have all the whitefish in Lake Winnipeg; nature makes it so that we can not catch them in the spawning season, and we do not want you to catch fish in other waters in competition with the Trust." Why did not Booth & Company favor the same laws before the Trust was formed that they do now?

Mr. Stranahan: Last year the commission took one hundred and eighty-five million white fish. We worked the ground from the mouth of the river to below Kelly's Island. We hatched one hundred and three million fry and turned them into Lake Erie. We believe that is more fry than nature could have possibly hatched. Of course, you cannot possibly prove that, but in order to do any fishing on the plan Mr. Whitaker proposes, we would have to fish hundreds of pound nets and miles of gill nets, which, of course, would not be practicable.

Mr. Whitaker: As I understand, that in effect is what our legislature has done this year.

Mr. Stranahan: It permits the commission to fish.

Mr. Whitaker: Yes, and it permits the United States Fish Commission, also.

Mr. Stranahan: They always could, but they had to get a permit. We could do nothing catching our own fish. We would get but few spawners out of many pounds of many kinds of fish, and it would be impracticable for us. I am in favor of a closed season, but I would make it October instead of November. I would close the lake tight shut for six months, three during the summer and three during the winter.

Mr. Whitaker: But you never could get such a bill through.

Mr. Stranahan: We had one, but it was not well enforced. As a matter of fact, the Pennsylvania people, and, in fact, a good many in Ohio fished 365 days of the year. It is only during a cold snap, when they can not get out of the mouths of the rivers, that they do not fish the season right straight through.

President Peabody: A committee was appointed to look up the question of entertainment. A number wanted to see the Falls and the various points of interest. Is it desirable that we close our session and have that opportunity before supper?

Mr. Willard: This question has been rather laid aside, owing to the prolongation of the session. The committee held a little meeting this noon, went over the matter and ascertained a few facts as to what we could see. (Mr. Willard here made a statement as to the various points of interest to be visited and the expense attending the same.)

President Peabody called for a report of the committee on nominations.

The committee on nominations submitted its report, and on motion duly seconded the persons nominated by the committee were unanimously elected as the officers of the society for the ensuing year.

For list of officers see title page.

Mr. Clark: Mr. President, I would like to make a motion, but previous to doing so I wish to say a few words, if I may be permitted. It has occurred to me that it would be a good idea for this Society to have a committee to call for papers from its members, instead of committing the work to the Secretary. That committee could call on different ones to prepare papers on subjects with which they are familiar. I have no criticisms whatever upon the Secretary. It has been the habit for years to ask members to send in such papers as they have. It seems to me it would be much better to have a committee to attend to that duty. That committee could get together and form a plan as to what papers would be of interest to the Society and could communicate with the different members, asking them to prepare papers on such subjects. I would therefore move that a committee of that kind be appointed, of which the Secretary shall be one.

Mr. de Ravenel: Unless the committee lived within a few miles of each other, or unless it is a committee of one, it would be difficult for them to confer by correspondence to arrange all these details; consequently, in selecting your committee it would be well to take that into consideration. This society embraces people from the Rocky Mountains to the Atlantic Coast, and unless the members of the committee were near together, they would not have very good opportunities for communicating with each other.

Mr. Stranahan: I will offer an amendment to that motion. Our newly elected Secretary is pretty well acquainted with the abilities of the members of this Association, and I move to amend by making this committee consist of the President and the Secretary.

The President put the question upon the motion in this form and the same was duly carried.

Secretary Whitaker: I want to say a word in reference to this program. We were notified that Mr. Fred Mather would present a paper on the "Value of the Gammarus or Fresh Water Shrimp for Trout Food." I have not heard from him. Mr. Titcomb's paper should have come second, but that is to be given tonight in the parlor. Mr. Clark's paper we have had. The next paper is "Observations on an Epidemic in Trout Fry at Allentown Hatchery," by Mr. Meehan. The next one is "Sturgeon Hatching on Lake Champlain," by Mr. Livingston Stone. He wrote me that he thought he would be able to be here with it, but wrote later that the sturgeon had not fulfilled their part of the business. The next paper is the "Fish and Fisheries of Maryland," by Hon. A. F. George. Mr. George is the only other person present having a paper. I would suggest that we now proceed with the paper of Mr. George.

THE FISH AND FISHERIES OF MARYLAND.

BY A. F. GEORGE.

No other State in the Union, in proportion to its area, has a greater coast line than Maryland. From a bulletin of the United States Commission published in 1894 we find that the States of New York, Pennsylvania, Delaware, Virginia, New Jersey and Maryland have an area of 159,635 square miles of which 7,635 square miles is water. Maryland, with one exception, the smallest of these States, has the largest water area of any mentioned—about 20 per cent of the entire surface of the State being water. New York has 1,550 square miles; Delaware, 90 square miles; New Jersey, 360 square miles; Pennsylvania, 230 square miles; Virginia, 2,325 square miles, and Maryland, 2,359 square miles. Other unassigned waters in Lower New York, Delaware and Raritan Bays, 720 square miles. The Chesapeake Bay, extending into the State for a distance of 120 miles, is from four to twenty miles wide and covers an area of 976 square miles. If we include its tributaries up to tide water we have an area of 2,359 square miles within the State. Then to this we add the inland rivers and mountain streams and we are not surprised to find the fish industry of Maryland to be one of the greatest in the country, occupying, as it does, a place in the front among the States engaged in the fishery industry. Nor are we surprised when the United States Fish Commission tell us that the fisheries of Maryland give employment to more than 41,000 persons, with an invested capital in 1890 of $7,649,904, having the largest fleet of vessels engaged in its fisheries and the most extensive packing and canning houses, while its fishing products, including shell fish, were valued at $6,019,165.

In each of eleven counties of the State there are more than one thousand persons employed in this important industry, Somerset county having the largest number engaged in fishing, larger in fact than any other county in the United States, with the possible exception of Essex county, Mass. Of the 23 counties of the State, sixteen of them border on important bodies of water—only one of which—Worcester—borders on the ocean. The others on the Chesapeake Bay and the rivers tributary thereto.

The census of 1890 shows Maryland to rank first as to the number of people employed in the fish industry, second as to amount of capital invested and second as to the value of products. While the natural advantages which we possess over some of our sister States are those for which Marylanders should be thankful, we can also boast of being foremost in our unsurpassed natural opportunities for improving and multiplying our fisheries. Maryland may well feel proud of the grand fisheries which nature has lavished upon her with such a bountiful hand, but she should not rest satisfied until she greatly improves the vast opportunities she has by increasing these great resources to their utmost capacity, which we believe will be done in the very near future by the thrift and intelligence of her people.

Never before were our people so much interested in this important matter as now. Never before has the public press given so much space to this great question as during the present year, and when the people fully realize the vast opportunities which they possess to increase their wealth by fully developing the fish industry, then it will not be long until our State makes very rapid progress in this direction and the fisheries of Maryland will become the most important in the country. The amount of money appropriated by our State for the artificial propagation of fish is not near so large as the importance of the work demands, especially when we consider the large returns made for the amount invested, but we are expecting great advancement along this line in the very near future.

Prof. Baird, ex-United States Fish Commissioner, has made the statement "than one acre of water properly cared for will produce five times as much as an acre of land." If this is correct (and we have no reason to believe that he who was so well versed in these matters made a mistake when he made the above statement) then what great possibilities lie before the people of Maryland for the increase of their wealth, for the employment of still larger numbers of her people and the furnishing of great quantities of the best food fishes at moderate prices. The thing that is needed to be done to bring this about is to give the Fish Commission larger means to properly develop the fisheries, to propagate the best kind of food and game fishes in larger numbers and enforce proper laws for the sufficient protection of the same.

The rivers and inlets of Eastern and Southern Maryland furnish a large supply of the very best food fishes, while in the rivers and mountain streams of Western Maryland can be found the bass, brook trout and rainbow trout. In Garrett county, which is the largest in area of any county of the State, there is fine trout fishing. There, nearly three thousand feet above the sea, you can find the beautiful speckled trout in its native element. In that county are more trout streams than in all the rest of the State combined. There brook trout have been caught twenty-three inches in length and weighing four pounds. There you can have the happiness and pleasure of angling for trout and bass which comes to every true disciple of Izaak Walton. The historic Potomac river, which is the southern boundary of the State, takes its rise up in these mountains and runs thence through some of the finest scenery in the country. This river furnishes an illustration of what can be done by stocking streams. Prior to 1853 there was no bass in the Potomac. In that year a lot of those fish were brought from Wheeling Creek, near Wheeling, West Va., in the tender of a B. & O. R. R. Co.'s locomotive and planted in the river. At the close of the war that river was one of the best bass streams in the United States and at this time there are certain parts where the excellent sport of catching large numbers of bass can be had. In 1870 some sportsmen of Pennsylvania successfully stocked several of their rivers with bass taken from the Potomac at Harper's Ferry, West Va. In the lower Potomac large numbers of shad are also taken; the annual catch being about 750,000. Among other important rivers we might name the Susquehanna, Patuxent, Pocomoke, St. Michaels, Choptank, Severn and several others in which there are important fisheries, giving employment to many of our people.

Among the fishes caught in our waters we mention the following, with their local names: Alewife or menhaden, blue fish, sheepshead, butter fish, crocus, sea bass, squeteague, spot, tautog, harvest fish, black bass, brook trout, rainbow trout, sea trout, shad, summer herring, croaker, Spanish mackerel, rock or striped bass, salt water chub, white perch, yellow perch, catfish and others.

The large variety and excellence of the food fishes of Maryland will compare favorably with those of any State in the Union. Of course in this short paper we do not intend to say anything of the diamond back terrapin and the Chesapeake oyster. It would require a longer and more elaborate paper than this one to describe their excellence.

Among our fisheries the shad takes first place. In 1880 the catch in Maryland was 1,074,121, valued at $140,326. In 1896 the shad catch of the Atlantic coast numbered 13,053,429, weighing 50,498,860 pounds and worth to the fishermen $1,-651,443; of this amount Maryland furnished 1,541,050 shad, weighing 5,541,499 pounds, valued at $166,551. The shad is our principal food fish, taking the lead both in quantity and quality. Before the artificial hatching of shad was introduced the supply was very limited but since that time there has been so much attention paid to this important work the supply has greatly increased. Capt. John Tyler, an old resident and fisherman upon the Manokin river, states that prior to 1885 shad were unknown in that river but after an interest was manifested in the artificial propagation of shad and the stocking of Manokin river they have greatly increased for the past ten years and are now being caught in large numbers. This has been the experience with all our rivers which have received proper attention in this direction. With increased interest in artificial propagation, the supply has increased from year to year. In some places where there was one fisherman catching a very small number, now there are ten, and the catch has increased greatly. In shad hatching we commence to strip the fish or take the spawn about April 1st, and continue as long as we can get ripe shad. It takes us from three to six days to hatch them. There is no doubt that had it not been for artificial hatching of shad they would now be almost as scarce as the diamond back terrapin. We have four shad hatching stations in Maryland operated by the State the past season from which 48 millions of shad were distributed. The United States Fish Commission also operates stations at Battery Island at the mouth of the Susquehanna and at Bryan's Point, below Washington, on the Potomac.

It has been well said: "In some respects the shad is the most remarkable of domesticated animals, for it is the only one which man has as yet learned to rear and to send out into the ocean in great flocks and herds to pasture upon its abundance and to come back again fat and nutritious to the place from which it was sent out." From this point of view, the maintenance of the shad fishery by man by the use of artificial means is one of the noble triumphs of human intelligence over nature.

The menhaden is not sold in our markets directly nor used for food by our people, although it is one of the most abundant fishes on the Atlantic coast. As a food for predaceous fishes the menhaden is an important fish and its commercial value is by no means small. The catch in the Chesapeake Bay has been in a single year 92,000,000 pounds of this fish, which yielded 214,000 gallons of oil worth $85,000; 105,000 tons of guano worth $210,000; 212,000 tons of compost worth $19,000, or a product in one year of $300,000. This fish is very abundant along the Atlantic coast from Cape Cod to Florida and has many local names. There are sixty establishments along the

Chesapeake for the manufacture of menhaden oil and fertilizers.

In the menhaden or alewife fisheries of the United States Maryland holds first place as to the number of fishermen employed, the amount of capital invested and the number of gill-nets, boats and traps. The number of the catch in the United States in 1896 was nearly 148,000,000, weighing 62,000,000 pounds and valued at $459,600. There are $26,000 invested in the alewife fisheries of Maryland. In 1896 17,667,315 pounds were taken, valued at $126,050, or more than one-fourth of the value of the entire catch of the United States.

The bay mackerel or Spanish mackerel, as it is often called, is known to our people as the bay mackerel. It is stated that many of our fishermen had never seen this fish prior to 1875. It is one of the choice food fishes of the nation. In 1880 Earl discovered that one of its chief breeding grounds was the Chesapeake Bay. It lays its eggs in the summer, each female depositing from 20,000 to 60,000 eggs. They are so small that there are 20,000 in a cubic inch. They float upon the surface of the water until hatched. The chief supply of our bay mackerel are caught with gill-nets or trapped in pounds.

We might say much more about the many other good fishes of Maryland: the perch, the bass, the trout, etc., but our paper is getting lengthy and we do not want to become tiresome. Many other varieties of choice and commercially valuable food fishes abound in our waters, famous as well for their extreme delicacy as for their abundance: the fine blue fish of the coast, the sea trout and striped bass, pike, white and yellow perch.

Too much cannot be said in praise of the Chesapeake Bay and the rivers of Maryland, of the great opportunities for development and for the increase of the wealth of our people from the fisheries.

We have these splendid natural resources, and we hope and believe that the time will soon come when Maryland shall take her proper place in the great work of the artificial propagation of fish.

Our Fish Commission is not so old as some, nor has it the means at command for investigation, research and experiment, which it needs, but we believe that in the near future the people of Maryland will fully realize the great and growing importance of this great work, and that all necessary money will be appropriated for the work of the Commission to give it the place its importance demands, and that the fisheries of our State will then be second to none among the great fish producing States of the Union; that then the large and valuable water area will be a far greater producer of wealth for our people than at the present time. We must have a great advancement in fish propagation and proper laws rigidly enforced for the protection of our valuable fisheries.

REMARKS FOLLOWING PAPER OF MR. GEORGE.

Mr. Dickerson: I would like to ask if you have any trout hatcheries?

Mr. George: There is one hatchery at Druid Hill Park, Baltimore, propagating brook trout and rainbow trout. We have put out more than five hundred thousand of these this season. We have also experimented with black bass.

Mr. Dickerson: When is your open season for trout?

Mr. George: We can catch them in April, May, June and July. The rest of the year is closed season.

Secretary Whitaker: Have you many trout streams in the State?

Mr. George: Yes, in western Maryland. Not many on the eastern shore.

Mr. Gunckel: I wish to state I have to return early this evening, and I would like to say that my home is at Toledo, Ohio, and any time any of you gentlemen are stopping in that little town I should be very glad indeed to have you call and see me. We have good fishing all around there and I will surprise you how I can catch fish. You gentlemen who have fished up in northern Michigan have your thousands of fish, but when you come there I will show you how you can catch fish where you can not see any, where there are no fish.

On motion, duly seconded, meeting adjourned until eight o'clock in the evening.

EVENING SESSION.

At the evening session Hon. J. W. Titcomb gave his lecture on "Photography and the Stereopticon in Fish Culture," with illustrated views with the stereopticon, after which the meeting adjourned until Thursday at 2 o'clock.

PHOTOGRAPHY AND THE STEREOPTICON IN FISH CULTURE.

BY J. W. TITCOMB.

"How are the little fishes?" "How are things going at the hatchery?" "Is this a good day for the fish?" and many other questions both relevant and irrelevant greet the ears of a fish culturist daily. The inquirers are frequently persons who know nothing whatever as to what the hatcheries of the country are doing nor their necessities. To one inquirer I recently made reply, "The fishes are doing first rate; I have twenty bantam hens sitting on brook trout eggs." Although more than ordinarily intelligent, my friend did not get around to question my statement until the next time I met him, when he wished to know if it is a fact that trout eggs are hatched under hens. The comparatively few who visit the hatcheries are surprised to learn that so much is being done by the States and United States to restock, or to keep stocked, the waters of the country which have become depleted of fish from many causes. They are surprised to learn that nature is so lavish in the reproductive powers of fishes but that she is so wasteful in caring for the spawn and fry of the parent fish; that while ninety and nine can be saved by artificial propagation, only one little fish comes to maturity in nature's folds. The professional fishermen often knows little about the habits of fish other than those which will contribute to his success in catching them, and from him most mistaken ideas of their habits originate.

As ignorance on any subject begets scepticism prejudicial to its interests, so the development of the fisheries by artificial propagation has often encountered opposition from legislators. It is the same ignorance which often opposes protective laws, drafted with special reference to the habits of the species protected. The objects of this society are usually carried out to the extent of reading papers upon relevant subjects, followed by a discussion of them. The benefits derived are many and are a source of profit and interest to the members and, through publication, to interested persons outside of the society membership. But they do not reach the masses. To do this, a means of interesting the people is suggested by illustrating the fisheries and the methods of artificial propagation. The camera is in almost every household; the means of obtaining proper illustrations are thus made simple. From appropriate photographic negatives lantern slides can be obtained at a reasonable cost in any large city. Many amateurs and camera clubs are doing this kind of work very successfully.

The illustrations presented tonight are merely suggestive of what can be accomplished. Any attempt to illustrate the work of the United States and the various State Fish Commissions in the short time at my disposal would be misleading. To go into details about the various pictures presented upon the canvas before a society of fish culturists and scientists would be presumptive. I will, therefore, ask you to view the subjects thrown upon the canvas as merely suggestive. I have used them in my own State to instruct the people as to what is being done within its borders and, at the same time, let them see of how little importance is our work compared with the work throughout the United States. I strive to show them the importance of fostering the resources which they now enjoy and which would be completely annihilated in a short time were it not for artificial propagation.

As Vermont is the natural home of the brook and lake trout, the black bass and (by introduction) the land-locked salmon, the propagation of game fishes naturally engages her attention more than the development of her commercial fisheries. Vermont's fishery resources are being developed for the purpose of attracting the summer tourists and thus the propagation of the game fishes is a profitable business proposition.

I will first illustrate trout culture as conducted by the U. S. Fish Commission in Vermont:*

To illustrate trout culture, photographs of field stations where the wild trout are captured and the various methods of capture are interesting. A photograph of the natural spawning bed makes an instructive picture. An explanation of how this was obtained will enable others to repeat the experiment successfully. This photograph represents a spawning bed of the wild trout in three feet of water near the shore of a lake. It is necessary to exclude the light between the lens and the surface of the water in order to secure a good photograph. A crockery barrel inverted over the bed with lens exposed through a hole in the inverted bottom was used. The barrel

*(*Foot Note.*—The preceding is Mr. Titcomb's opening address, which was followed by 100 lantern slides briefly explained. What follows is designed for printing in the transactions of the society as a suggestion to those who would take up similar work but suited to the needs of the communities where the illustrations are to be explained.)

reached just below the surface of the water and the light which reached the camera came through the water itself. A better arrangement and one easily transportable can be made by a four-legged stand as a substitute for the usual tripod surrounded by a skirt of black cloth; the cap to be arranged with a hole in it through which the lens can be exposed. A bag of cloth around the cap can be drawn around the camera and held in place with a rubber band. Although the trout had left the bed when this exposure was made, I believe it possible to photograph them upon their beds another season.

Sorting and stripping fish makes another interesting illustration, with accompanying explanation of method of fertilization, etc. Various methods of eying eggs in stacks or as laid down in the hatching troughs can be easily photographed. Methods of packing eggs for shipping long distances can be illustrated and explained. In fact, all the details of a hatchery can be easily illustrated. The fry in their various stages of development make very attractive illustrations. In order to get good photographs of the fry in the troughs, or other trough work, a rude stand can be made to fit the troughs so as to sustain the camera with the lens in a vertical position facing directly into the troughs. The focal distance can be adjusted by having several auger holes through the back of the stand which supports the camera. The photographs can be taken by either flashlight or daylight. Daylight produces the most successful results for most of these pictures.

Fry monstrosities interest people and can best be photographed by placing them upon a glass plate with a white background a few inches below the glass. Some of the enemies of fish spawn naturally deposited and resultant fry can be photographed the same way. It is desirable to impress upon the people the reasons why artificial propagation is such a great improvement over the natural methods of reproduction. In fact, if all the spawn of all the fishes in the waters of our country hatched and became fishes, the time would soon come when there would not be sufficient water to sustain them. If salmon work is to be illustrated, similar photographs can be taken, together with methods of collecting the spawning salmon. Views of salmon actually leaping a falls 18 feet high, some of them showing the fish entirely out of water, are especially interesting. These were obtained by borrowing negatives from sportsmen from which to make the slides.

The comparative size of different fish eggs and fry contemporaneously hatched make a good illustration. Pike perch fry make a very good picture in contrast with trout fry. This picture is taken by placing the objects upon a glass plate with light colored background below the plate. Pictures of rearing ponds and troughs, fingerling fishes, adult fishes, adult fishes of different varieties in comparison, *all* contribute to knowledge of the people. Methods of transportation of fishes, methods of feeding fishes, both young and adult, can be illustrated and explained. A live food box or "odorless maggot box," which can be used on ponds both artificial or natural, where artificial food is required, is here described in detail, because I have never seen anything like it before. The object of this box is to have a receptacle for waste meat, which, when properly charged with fly larvae, can be placed in a floating box tightly closed with a cover whose lids extend down into the water. The bottom of the meat trays in the box are covered with coarse wire cloth, the odds and ends of old hatching trays. Excelsior or straw is placed in the trays and then the fly-blown meat laid on it. As the maggots hatch out, they clean themselves in working through the excelsior and drop into the water where the fish lie in wait for them. The parts of this box consist of an outside frame which is merely a box without a top or bottom placed upon floats. Two movable trays are fitted into this frame on cleats, side by side. Two small trays are used instead of one large one, so that the meat can be renewed alternately, thus keeping a constant source of supply of larvae.

In illustrating the commercial fisheries of the country, their importance can be explained by deductions from the following table:

Statistics of the Commercial Fisheries of the United States.

States.	Persons employed.	Vessels.			Boats.		Other property.	Total investment.	Products.	
		No.	Net tonnage.	Value, including outfit.	No.	Value.			Pounds.	Value.
Alabama	1,196	53	522.18	$50,945	541	$16,372	$112,359	$179,676	6,568,781	$206,937
Arkansas	750				561	7,917	28,647	36,564	3,875,858	116,011
California	4,820	66	9,796.87	1,154,685	1,479	124,380	1,336,469	2,615,534	50,065,734	1,794,729
Connecticut	3,047	208	3,269.68	662,252	1,353	98,595	2,065,987	2,826,834	61,458,221	1,871,413
Delaware	2,392	42	554.00	37,854	953	39,349	330,616	407,819	8,834,797	247,488
Florida	6,143	185	2,804.76	470,068	2,148	150,348	680,001	1,300,417	33,983,234	1,085,398
Georgia	1,869	51	641.80	28,833	680	20,277	235,754	284,864	4,993,100	170,605
Idaho	57				30	540	1,835	2,375	235,058	11,929
Illinois	2,656	4	116.77	18,495	1,694	56,064	929,693	1,004,252	12 631,505	371,410
Indiana	919				890	8,546	23,292	31,838	2,746,383	131,567
Iowa	944				739	14,797	31,913	46,710	4,079,704	124,851
Kansas	61				61	683	2,728	3,411	242,387	11,022
Kentucky	587				639	10,175	25,319	35,494	2,273,585	90,024
Louisiana	5,666	61	395.82	41,646	4,307	249,477	295,629	586,752	23,675,891	905,599
Maine	14,129	408	13,136.67	813,752	5,920	237,469	1,838,572	2,889,793	121,700,200	2,225,806
Maryland	42,812	1,419	23,670.00	1,344,542	10,077	562,455	3,914,613	5,821,610	88,588,018	3,617,306
Massachusetts	17,238	836	59,259.30	4,639,168	3,494	254,033	8,352,028	13,245,229	301,349,331	7,531,194
Michigan	3,351	64	1,380.87	326,928	1,673	103,689	1,213,551	1,674,168	34,019,915	964,279
Minnesota	1,075	2	266.52	42,400	703	44,463	181,649	268,512	7,307,165	185,649
Mississippi	2,992	83	854.88	107,063	605	20,500	405,307	532,870	10,043,755	248,392
Missouri	575				523	11,221	32,984	44,205	3,821,654	119,786
Nebraska	76				50	534	2,187	2,721	340,466	14,015
Nevada	39				30	600	83	683	42,821	3,056
New Hampshire	365	15	588.05	43,099	73	4,170	65,391	112,660	3,956,824	91,481
New Jersey	10,467	629	7,879.22	873,822	5,618	387,491	1,176,167	2,437,480	73,267,434	3,646,382
New York	14,052	665	9,409 40	1,011,109	6,879	401,686	4,374,140	5,786,935	176,040,903	5,045,560
North Carolina	11,945	174	1,879.23	151,375	4,378	201,709	864,125	1,217,209	63,857,457	1,301,629
Ohio	2,353	59	797.26	223,432	967	117,876	1,340,650	1,681,958	30,194,846	567,039
Oregon	6,323	23	468.07	54,009	2,022	212,925	2,370,478	2,637,412	38,141,632	1,282,036
Pennsylvania	2,301	55	871.00	143,375	598	54,405	1,686,986	1,884,766	18,469,107	480,629

Statistics of the Commercial Fisheries of the United States.—CONCLUDED.

States.	Persons employed.	Vessels.			Boats.		Other property.	Total investment.	Products.	
		No.	Net tonnage.	Value, including outfit.	No.	Value.			Pounds.	Value.
Rhode Island	1,757	69	1,484.79	$223,735	651	$62,743	$733,700	$1,020,178	127,365,475	$935,144
South Carolina	2,139	16	252.93	15,742	1,056	34,080	124,532	174,354	5,280,446	210,456
South Dakota	121				97	938	1,973	2,911	416,920	13,261
Tennessee	520				446	4,879	25,324	30,203	2,445,291	82,502
Texas	1,199	45	508.81	51,684	686	77,911	107,901	237,496	7,174,550	286,610
Utah	630				90	1,175	10,560	11,735	1,230.124	37,479
Vermont	169				56	1,090	3,704	4,794	208,139	7,160
Virginia	28,216	1,055	15,218.00	914,824	10,302	493,276	1,483,436	2,891,536	277,627,455	3,167,866
Washington	6,212	59	1,420.56	160,384	2,646	170,155	1,693,930	2,024,469	59,079.527	1,401,433
West Virginia	67				51	2,630	1,445	4,075	162,021	8,701
Wisconsin	2,371	41	654.06	164,092	956	50,894	555,998	770,984	21,593,673	529,415
Total	204,601	6,387	160,101.50	$13,769,313	76,722	$4,312,517	$38,691,656	$56,773,486	1,689,389,387	$41,143,249
Alaska (estimated)	6,410	89	28,698.00	897,000	1,151	148,620	3,637,060	4,682,680	88,480,204	*4,053,011
Grand total	211,011	6,476	188,799.50	$14,666,313	77,873	$4,461,137	$42,328,716	$61,456,166	1,777,869,591	$45,196,260

* This represents in most cases the market value of prepared products, as canned salmon, etc.

The work of the United States Fish Commission can be referred to in this connection: For the years 1897-1898, thirty-six varieties of game and food fishes were propagated, and the distribution of fish and eggs amounted to 860,206,677. The table of distribution for 1898-1899 has not yet been completed, but I am informed the output will exceed one billion.

Views of various hatcheries about the country and the work they are accomplishing, methods of hatching different varieties, etc., etc., will interest and instruct the people. If game is a matter of interest in connection with the fisheries of a community, a few slides on wild game will add to the interest of the audience and, at the same time, an opportunity is given to illustrate why game must be protected and why game, except in a few instances with species of game birds, cannot be artificially propagated more successfully than by the natural methods, as is the case with fishes.

Having interested and instructed the people as to the necessities for artificial propagation of fish or for the protection of game, the natural sequence should be that the representatives of the people, voicing public sentiment, will act favorably upon legislation furthering these objects.

Perhaps I ought to add here that the preparation of negatives from which suitable slides can be made is not so easy as to secure ordinary negatives of scenery or even of interior views. The work involves more or less experimenting when strictly fish cultural slides are wanted, although for views of hatcheries and the illustration of the fisheries in general negatives can usually be borrowed. The writer has had especial facilities for obtaining photographs and negatives, in that one of his employes, Mr. A. H. Dinsmore, is not only a good photographer, but can make first-class slides.

AFTERNOON SESSION, SECOND DAY.

The meeting was called to order by the president at 2 p. m.

Secretary Whitaker: I have a paper here on "Fish Culture in North Dakota," by W. W. Barrett.

On motion, duly seconded, the same was ordered read by title and to be printed in the report.

FISH CULTURE IN NORTH DAKOTA.

BY W. W. BARRETT.

Church's Ferry, N. D., June 6, 1899.

To Members of the American Fisheries Society:

Fellow Workers—I regret that circumstances will not allow me to be present at your meeting at Niagara Falls on June 28th and 29th, and enjoy the amenities and intelligent thoughts of the assembled scholars, who constitute the American Fisheries Society, but as I feel a deep interest in the propagation and culture of fish, I will present in this form, something in regard to this subject as it pertains to North Dakota. In order not to consume too much of the valuable time set aside for your deliberation, I will give but a brief letter.

PIONEER WORK IN FISH CULTURE.

North Dakota is a young State, and as yet limited as to the matter of State revenue, hence it has not established a State fish hatchery, neither has it made any appropriation to carry on the work of fish culture. But for the last ten years the Department of Irrigation, Forestry and Fish has been established and in successful operation, and during all this time the duties thereof have been entrusted to the care of the writer. Fully alive to the importance of making a success of the increasement of fish in our State, I have taken active measures and been enabled to secure, mainly from the United States Fish Commission, a generous supply of fish for our waters, and the outcome has been most favorable in the enlargement of the amount of this species of food.

THE HOME FISH CULTURE SYSTEM.

For many years I have advocated what I term The Home Fish Culture System. It embodies these features: The creation of artificial ponds by holding back, by means of suitable dams, the flow of water in creeks, from springs and artesian wells (we have over seven hundred flowing artesian wells in North Dakota) and the creation of reservoirs by excavations in the ground, and the filling of the receptacle from common water wells, the water being lifted by means of wind and other power.

At first the system was looked upon with indifference and some opposition, but being based upon what seemed good sound principles and having been made practical in many parts of our State for a series of years, its advantages are now conceded. Through this plan numerous farmers are now raising large quantities of fish, and many more will try the experiment as soon as the supply can be obtained from the writer or elsewhere. Two years ago I furnished five thousand (5,000) lake trout fry to a farmer living near Oakes, N. D. He planted them in an artificial pond made by damming up the waters from a spring upon his farm. A few days ago I received a letter from him. He is very enthusiastic and much delighted because his fish raised from the fry are most plentiful and measure from ten to twelve inches in length—speckled beauties affording rarest sport, as they take the bait most readily.

The benefits attending the carrying out in practical detail of the Home Fish Culture System demonstate it contains true merit, and is worthy of studious attention, as it indicates fish culture, at a small expense, can be made a profitable factor in diversified farming or rural life. It has many desirable advantages, some of which I here mention: It is an inexpensive system; under proper management, it is certain, as a rule, to supply a large amount of cheap and nutritious food for the family; it can be made a source of revenue, if desired, by sales of the fish, and what is a most desirable feature, no person has a legal right to take the fish without the consent of the owner. Besides all these profits, the fish are near at hand, so the pleasure of angling can be indulged in at any time and fresh fish had for the table when desired, and the culture of the finny tribe at the home place is most fascinating and instructive to the family, especially to the young studying the works of nature in beautiful development.

It is gratifying to know the interest in this home fish culture system is constantly increasing in our State.

I am also, thus far, meeting with the best of success in my experimentations with the raising of fish in artesian water.

This pioneer work of fish culture in North Dakota is being carried on under the most adverse circumstances, the principal difficulty being there is no appropriation made by the State to cover the expenses, but the results are most encouraging and it is reasonable to suppose they will lead to some tangible action by which our State will be made to take a front rank in the matter of artificial fish culture.

The work of the American Fisheries Society is worthy of the fullest commendation, as it deals in an intelligent manner with vast economic problems involving the material welfare, support and comfort of the people throughout the Union. I cannot but trust your deliberations at this meeting will be attended with interest and profit to yourselves, fitting for large usefulness in the great and important work assumed by the association.

Respectfully yours,
W. W. BARRETT,
State Fish Comm. of N. D.,
Church's Ferry, N. D.

Mr. Titcomb: Mr. President, the success of any organization of this kind usually depends upon the work of one man, and I think as a rule it has been the Secretary in this Association. In recognition of the services of Mr. Whitaker, who retires from office at this time, I move a vote of thanks of the Society be extended to him for his services during the past two years. I am sufficiently familiar with the running of such organizations as these, and in filling such offices, to know that the Secretary has much work to do, and I therefore move that the Society extend to Mr. Whitaker for his services a vote of thanks.

Mr. Bowman: I second the motion.

The President put the question and the same was unanimously carried.

Secretary Whitaker: I would like to say just one word in this connection. There is only one thing that would have induced me to take the office of Secretary in a society like this. For years we were having proceedings regularly taken and we were not getting them printed and in the hands of members until sometimes within a month or two of the time of the next meeting. I took the office for the simple purpose of demonstrating that the thing could be done, and it has been done.

President Peabody: Professor Reighard is the only author of a paper who is present at this session, and as some of the gentlemen are going to leave on an early train, if there are no objections, I think it would be best to have Professor Reighard read his paper at this time.

A PLAN FOR THE INVESTIGATION OF THE BIOLOGY OF THE GREAT LAKES.

BY PROFESSOR JACOB REIGHARD.

It is not necessary for me to point out in detail to an assembly like this how little we really know of the life in our Great Lakes. We do not know fully the life history or the food habits of any one of the commercial fishes. Much less do we know of the life history, food habits or breeding habits of the many animals and plants that surround these food fishes and upon which they are dependent.

In spite of this we are necessarily at work having laws made for the control of the fisheries. We are, perhaps also necessarily, spending large sums in artificial propagation. All this we are doing without any adequate knowledge of the materials with which we are at work.

It may be said that this, which is true of the fisheries, is true also of many other undertakings; that the physician knows very little of all that is to be known of the physiology of the human body—very little of all that is to be known of the action of remedies on that body—but that in spite of this, his work is, on the whole, of value. Like statements may, with entire truth, be made about many other lines of human activity. What we really know, compared with what we might know, is but little in any direction. But let us assume that we know as much of all that it is possible to know of the conditions of life in the Great Lakes as the physician knows of all that might be known of the human body. And yet the physician, without complete knowledge, often indeed with very little knowledge, reaches results, while the student of the Great Lakes has yet to prove the benefits of either legislative or fish-cultural doctoring.

The reasons for this are not far to seek. In most affairs of life we learn by experience what measures bring the desired results. The physician has abundant opportunity to test his medicines and to bring his tests to a speedy conclusion. He has most often learned what is good, not by scientific induction, but by experience. In other words, the art precedes the science, practice comes before theory, and this is usually true of human affairs. In the lake fisheries, matters have taken the same course, and, so far, without demonstrable success. We must, it seems to me, seek the explanation for this lack of success in two conditions.

In the first place, the problem of the lakes is so vastly complicated that it is difficult for the student or scientific man to even guess, in the present condition of knowledge, what should be done toward the solution of any fisheries problem. In the second place, it requires a great length of time and large sums of money to learn by experience alone what is necessary. To put the matter in another way, we have not the data at hand from which to decide inductively what it is best to do in any given problem of the lakes—while, on the other hand, we have not, as yet, had either time or money to find out, as the physician usually does, by the cut and try process—that is, by simple experience, what it is best to do.

The question then seems to me to be, since the fisheries problems of the lakes are unsettled, whether it is best to spend money and time in trying to settle them by experience, ignoring other methods, or whether it is best first to determine scientifically the factors entering into our problem. Personally, I believe that in this matter progress by experience is, to an unusual degree, a matter of chance, like hunting for gold. It is costly, time-consuming and dangerous, and may lead to nothing or worse. On the other hand, to investigate the biology of the lakes is to make progress toward the solution of the problems of the fisheries. This progress may be slow, but it is, in the very nature of things, certain. I believe that such scientific investigation has become a necessity to further progress.

If this be granted, it will at once be asked by those whose aims are practical, whether it is not enough to investigate practical problems as they arise. It may be granted that the failure of a certain fishery or the prevalence of disease among certain fish is a matter demanding scientific investigation, and yet it may be thought that any more extended investigation is a matter that does not really concern the fisheries, and that may, therefore, properly be left to the unaided efforts of men of science. Those who hold this view should not forget that the inhabitants of the lake are so intimately related to one another and are so directly influenced by the physical conditions of the lakes that a consideration of any one of these things is not merely likely, but almost certain to involve the others. An investigation into the causes of decrease in the whitefish may involve a study of the chemistry and bacteriology of the water or of the physical properties of the under-lying soil. Is it not better, then, to enter at once upon a study of as many as possible of the elements that are likely to enter into the practical problems that now confront us or that may confront us? Is it not better, in other words, to take up the study of the biology of the lakes from the point of view of pure science for the purpose of finding out as far as possible the facts and of making clear as many as possible of the principles? Then when, in the future, any fisheries problems arise, the facts and principles for their solution will have been already in large part determined. Such a course does not preclude the immediate investigation of certain pressing problems of interest to the fisheries. It does bring into prominence the fact that such investigations are not in themselves sufficient, are likely to be inconclusive and can in no sense be considered final.

There is still another reason why it seems to me that the investigation of the lakes may best be undertaken on a purely scientific basis without direct and necessary subservience to the fisheries. We have had almost within my memory two distinct phases in the evolution of natural history subjects. During the first of these the principal aim of botanists and zoölogists was to collect and name as many species of animals and plants as possible. That man was considered the greatest zoölogist who could repeat correctly the Latin name of the largest number of animals. I do not wish to underestimate the value of such knowledge. It is necessary preliminary knowledge. I wish merely to point out that it is not of the greatest use to the fisheries. While any work, of whatever sort, that is done in the lakes must take account of the systematic names of the animals and plants of the lake and of their distinctions, I am unable to see how a science devoted largely or exclusively to such knowledge can greatly benefit the fisheries.

During another phase in the development of natural history, a phase in which we still are, attention was turned to the anatomy and development of animals and plants. Zoölogists believed that animals were related to one another, that a process of evolution produced one from another and that by a study of the structure of these animals their relationship to one another could be discovered. This hope is being largely modified or abandoned. Zoölogists are indeed convinced that evolution has taken place, but just what the resulting relationship is that obtains among existing animals is largely a matter of speculation or of personal opinion. Again, in this phase of the development of zoölogy and botany it seems to me that the interests of its students are not along lines that are of great use to the fisheries. It is of course true that a knowledge of the anatomy, development or relationship of an animal is very likely to be of use in the discussion of fisheries problems, but it is equally true that so long as a science makes such knowledge its chief aim, largely to the exclusion of other knowledge of animals, it fails to give to the fisheries the aid of which it is capable. I doubt if it can be shown that the fisheries have ever been directly benefited by either anatomical or systematic studies.

Naturalists are now becoming convinced, since evolution is taking place under their eyes, just as it took place in the past, and since the same forces that have in the past been at work modifying animals are still at work, that these forces must be studied. Although these forces lie largely in the environment of animals, the most important thing is neither the animal nor its environment but the relation between the two. For an intelligent understanding of the subject of evolution naturalists want to know all about the conditions under which animals live—about their habitats, their food, their enemies, their parasites, their rate of growth, their daily habits, their length of life, their rate of increase, their breeding habits and many other things.

The things that are thus again coming to interest zoölogists are precisely those that are important to the fisheries. When a few years ago the regular scientific work of naturalists was, as it still is, largely anatomical, developmental and systematic, it was of only secondary interest to the fisheries. Now that such work is changing in character it is likely to furnish the very materials that are most needed for a full understanding of the fisheries.

I thus find two principal reasons why, as it seems to me, a broad investigation of the biology of the Great Lakes, undertaken from the point of view of pure science, is likely to prove of more value to the fisheries than a series of minor investigations undertaken for the purpose of solving isolated practical problems. The first of these reasons is to be found in the complexity of the conditions existing in the lakes, making the investigation of isolated problems from a purely practical standpoint unusually difficult and likely to result in failure. The second reason lies in the present trend of natural history studies, so that the facts of interest to the man devoted to pure sciences are the very facts which have value for the fisheries. Other reasons might be cited for investigations along purely scientific lines, but I shall confine myself to these two.

If, as I believe, it is best for the fisheries that an investigation of the lakes be undertaken from the point of view of pure science, it remains to ask how such investigation may best be carried on.

I shall try to answer this question categorically:

1. *Investigations should be carried on throughout the year.* So long as animals were merely to be named or their anatomy studied it was sufficient to collect them during the summer and to preserve them for work during the winter following; but when it becomes necessary to study the habits of animals over long periods, their rate of growth and other similar questions, the observations must of necessity extend over long periods of time, sometimes over many years, and summer work alone no longer suffices.

2. *The work must be done by a permanent staff of investigators.* The problems of the lakes are not to be solved in a day nor in a year. They will require the continuous labor of many men for many years. I presume that the unsolved problems of agriculture are as numerous and as pressing as ever in spite of the army of men that has for many years been at work upon them. It is the same with the fisheries. In twenty years some of their problems may be settled but there are sure to be others quite as pressing. At present most of the scientific work relating to the fisheries is in the hands of college or university teachers who spend at it their summer vacations and such time as they can spare besides. Such a condition of things can be only temporary. Professor Birge has very well said: "With all due respect for the college professors, I don't think they can do that work permanently." The men who do the work must have time to think about their problems, they must live with them, day and night, year in and year out. Time and a high order of ability are needed and these must be well paid. There is of course work that can be done by college men during their vacation time and arrangements should be made for their doing such work. My criticism here is not that college men are engaged in this work but that they are engaged in it to the exclusion of others. Their part should be secondary, whereas it is now the principal part. Any plan for the investigation of the lakes should include arrangements whereby college men and others, not regular members of the laboratory staff, may be provided with facilities for carrying on their investigations. These facilities should be provided without cost, and in certain cases investigators from the colleges should be encouraged by financial aid and by other means to carry on their investigations in connection with a central laboratory. Thus, in addition to a permanent staff of investigators, there should be a subsidiary staff drawn largely from among university and college teachers.

3. *It follows that a permanent laboratory needs to be established.* Such a laboratory should be located if possible near both deep and shallow water. It should be upon the shore of one of the Great Lakes, but at the same time upon a good

stream of clear, cold water and not too far from diversified inland lakes. It should have workrooms for investigators, an abundance of large and small aquaria, with suitable appliances for furnishing air and water. It should be equipped with all the modern appliances, with microscopes and other optical apparatus, and especially with experimental apparatus. There should be rooms for chemical work in charge of a competent chemist. There should be a physical laboratory suitably equipped. Photographic rooms and photographic appliances are necessary. A mechanical workshop with a skilled mechanic who can construct and repair apparatus is also a necessity. Other things will doubtless occur to him who undertakes to prepare detailed plans for such a laboratory. Near the laboratory there should be breeding ponds of various sorts so arranged that the temperature of the water may be regulated.

In connection with such a laboratory it is necessary that there be *a movable laboratory of some sort.* Possibly a steamboat fitted up to be used as a laboratory best serves this purpose. In place of a steamboat a small laboratory building that may be taken to pieces and again set up in another place may be used. Such a portable laboratory could be quickly moved from place to place for scientific work or for the investigation of any problem of the fisheries that might arise. It is a necessary adjunct of the central station.

4. *Whatever the location selected for the central station, it should be easily accessible* at all seasons of the year and from all parts of the country. This is so obvious an advantage that it scarcely merits further discussion.

5. *It seems to me that work such as is here described should be carried on in some relation to a university.* Universities are the centers in which scientific work is most cultivated. Aside from the city of Washington they may be said to be the only centers in which such work is cultivated in this country. The individual worker is there stimulated by contact with fellow workers, and his results and ideas are tested before publication by being subjected to the criticism of his fellow workers. These are advantages not enjoyed by workers in isolated institutions. For these reasons it seems to me that some relation should exist between such a scientific institution as I have described and some neighboring university. As to what precisely should be the nature of this relation, I do not at this time undertake to say.

I have sketched this plan in outline only. The details remain to be considered and filled in. Many of them can be suggested only as the result of experience, but a plan something like this seems to me to afford the best chance to reach lasting results in the many problems that concern the fisheries. I have brought this plan forward here in skeleton form in the hope that it might provoke discussion. I shall be very glad of any suggestions or criticisms either public or private, and can assure you that they will be of assistance in defining and developing the plan.

DISCUSSION OF PAPER OF PROFESSOR REIGHARD.

Mr. Clark: Mr. President, it seems to me that we ought not to let this paper pass without some thought in connection with it. It impresses me that it is a vital thing—the question of the study of the fisheries in the particulars referred to by Professor Reighard. It is a subject that I am very much interested in, for one thing, because there are so many questions asked me in regard to what the fishes do. I am very frequently asked what the peculiarities of various fishes are in this direction and that direction. A question was asked me at dinner and I had to say that I did not know. As a fish culturist of twenty-five or thirty years standing, it is a little embarrassing to answer in that way, but we have to do it; there are so many things in regard to fish that we know comparatively little about, even in regard to the fish that we are hatching, and it is utterly impossible for practical fish culturists to investigate in that line. The points brought out by Professor Reighard, it seems to me, is where the great study today is, and very vital to the increase and success of our work.

Mr. Parker: Mr. Chairman, I was going to say that the writer's comparison as to the physician is a very happy one. The scientific physician and the empirical physician are entirely distinct from each other. The former mingles science and his practice together and is the one who gives us the best results. It seems to me that in connection with the fish interests the same rule will apply. It is science wedded to practice that is going to give us what is best and which will be of the most use, not to science alone, but to the practical interests of the fisherman. It seems to me that the plans outlined here, together with those which practical men can outline, would be of immense benefit to the country, not only to the Great Lakes, the work on which he has alluded to, but to the seashore, the doing of the work that is being done at Woods Hole and which Professor Bumpus told us about here yesterday. All of these things, it seems to me, go hand in hand, and it is for this Society to take these things up and see what can be done with them.

Mr. de Ravenel: I am obliged to leave in a few minutes to go to Buffalo, but I want to say I heartily indorse what has been said by both Dr. Parker and Mr. Clark in reference to Dr. Reighard's paper. There is no question at all, if we expect to get the best results from fish culture, we must bring in the biologist, and we must study thoroughly the conditions that surround the animals that we are attempting to preserve and propagate. In regard to the general lines Dr. Reighard has laid down, I must say frankly as a practical man that the expense involved in carrying them out would be very large, and I am afraid unless we make a much more modest start that it would be difficult to get Congress to enact the needed legislation. The cost of a vessel like the Albatross would be up in the hundreds of thousands of dollars, and the establishment of a complete biological laboratory and aquarium would make the cost of such a station a hundred thousand dollars. I am not speaking recklessly on that question. Your ordinary biological stations cost from forty to fifty thousand dollars without any of these attachments. I think that I am within bounds in saying that the Woods Hole station cost from sixty to eighty thousand dollars. I would like to ask Mr. Bowers if he knows about that.

Mr. Bowers: From sixty to eighty thousand dollars.

Mr. de Ravenel: I think, then, we would have to start off in rather a modest way, but in such a way that we can develop as the time goes by. I hope Professor Reighard will keep this matter agitated and that we will in a few years see a biological station established on some of the Great Lakes.

Mr. Titcomb: I will inquire of Mr. Reighard is he thinks a resolution of this Society, indorsing such a movement, would be of any special assistance.

Secretary Whitaker: We did indorse it last year. The matter was brought up and received the warm and hearty indorsement of the Society. It was quite fully discussed at the last session, and I do not think the Society has changed its mind since that time.

So far as the practical side of this question is concerned, my views were expressed very fully a year ago. The Professor well knows that Michigan undertook to do something of this kind, to investigate the conditions of plankton and of the larger forms of life in the Great Lakes, and also of their flora so far as that subject was related to the food fish and their supply of food. What we had in mind at that time was, of course, on very much narrower lines than is proposed in the Professor's paper, because of the very thing that has been suggested here—the lack of means would not warrant anything of that kind. I think that any one who has been connected with fish culture, directly or indirectly for any length of time, appreciates the meagerness of our knowledge regarding the conditions in the Great Lakes affecting the life of the commercial fishes themselves. One of the things that I talked with the Professor about at the time we were carrying on these investigations was the desirability of definitely determining whether certain localities furnished more fish food than others, which had a practical bearing on the question of where fish should be planted. Of course, we take the ground, and it stands to reason, that where the fish deposit their spawn is the proper place to deposit the young fish with best chances of success. Presumably there is a food there for the young fish when they are hatched naturally.

There is another thing I think it would be interesting and of value to know, and that is when the emigration of the young fish commences from spawning beds? Do they change the character of their food as they grow older, and what are their movements during the year? There are many things that might be suggested as proper subjects for investigation. It seems to me, with the amount of money the United States Commission has at its disposal, while they have a great many channels into which it can be turned, that a station equipped with buildings of reasonable cost which would answer the purpose and arrive at the results, might be established without an extravagant expenditure of money. A fitting illustration of this idea was presented by our friend Titcomb last night in his lecture. He showed us a cheap station where he has accomplished nearly the same results as the St. Johnsbury, and I should presume, from the looks of the picture, that the cost was much less than that of the St. Johnsbury station. I hope the matter will not be dropped, but that means may be found by which Professor Reighard's plans can be carried out.

Mr. Reighard: You asked me whether I thought it would be an advantage to the Society to take some action in regard to this. It seems to me it would. You gentlemen have much more experience in such matters than I have, but it seems to me that a resolution passed by the Society, or perhaps the appointment of a committee by the society, would aid very materially in furthering this plan.

Secretary Whitaker: Action was taken last year. I had forgotten about it when you spoke to me about it some time ago; but this idea was fully indorsed last year and a resolution was passed asking that it be carried out.

Mr. Clark: The idea of the Professor now is, to have a committee appointed to formulate a plan in the line of a permanent station.

Mr. Reighard: I say, Mr. President, I do not know much about how this Society works, I am only recently a member of it, but I should think a committee could do something, not merely in formulating plans, but to hold itself ready to do whatever would be necessary, provided the Society wishes to commit itself to this plan.

President Peabody: To bring about the desired result, I should think that the fish commissions of the states bordering on the lakes might take up this matter jointly and use their influence with their members of congress to secure an additional appropriation for this purpose. It seems to me that is the practical way to arrive at it.

Secretary Whitaker: I addressed some letters to Congressmen and Senators from our state, last year, on this subject. I should fancy from the remarks of Mr. de Ravenel, who, I presume, speaks with authority, that what is to be done has not yet been fully determined. I presume this is all tentative, but until the United States Fish Commission determines what it is going to do in the matter it might be a loss of energy to do anything further with it. It has had our indorsement. I am not particular about it, but merely make that as a suggestion.

Mr. Titcomb: It is my impression the United States Fish Commission is ready to do anything they possibly can when they have the money to do it. I think that is the idea we have obtained from the present Commissioner. Now, if this Society can do anything, can add any influence by offering a resolution at the present time, which might be of use to the United States Fish Commission in obtaining an appropriation, I think the Society ought to do it. And further, if it would be of any use for the Society as a society, through a committete appointed at this time, to use their influence with the representatives in Congress from the states bordering on the Great Lakes, to take hold and back up the United States Fish Commissioner in these matters, that the Society ought to do it. If it is the sentiment of the society that such a committee could be of use in organizing a movement along the lakes, looking to this result, I should be glad to see such a committee designated. I merely make this as a suggestion.

Mr. S. Bower: Mr. President, in order to bring this matter to a focus, I desire to make a motion. I move that Professor Reighard be invited to formulate a circular letter, which, when it is ready, and when the proper time arrives, shall be fathered by this Society and be sent out as emanating from this Society through its President. I think such a letter would have considerable influence, and a copy of it could be addressed to every member of the Society throughout the United States and to every fish culturist, and to everybody who is interested in the fisheries; to our Congress and to our representatives in the State legislature, and to everyone who might be interested and willing to co-operate in bringing influence to bear upon Congress. In that way I think we might create quite a good deal of public sentiment in the matter, and directly or indirectly it might have a good deal of weight with congressmen, and when the matter was brought to their attention by the United States Fish Commissioner it might have a good deal of bearing upon the amount that they would be willing to allow for this purpose. I make this as a motion.

The motion was duly seconded, and the question being put by the President, the motion was carried.

President Peabody: I would like to ask the Commissioner, if five congressmen on the lakes should ask for an appropriation, if it could not be brought about?

Mr. Bowers: It would be necessary to ask for an appropriation for scientific inquiry. If I am not mistaken this Society took some action a year ago on this matter, and on my recommendation the appropriation was increased from ten thousand eight hundred to fifteen thousand dollars, and on account of the increase an opportunity was to be given for work on the Great Lakes, and this work is now being carried on under the direction of Professor Reighard. It has been my intention to recommend a still further increase for that division, and I have thought of asking this year for twenty-five thousand dollars, and from time to time to increase it as it can be done.

President Peabody: If that is backed up by the personal work of the congressmen it would be easily carried out, would it not?

Mr. Bowers: Yes, I think so; but, after all, it devolves upon this Society to bring such influence as it can upon its representatives both in the Senate and in the House, for if we have good appropriations we can do good work.

President Peabody: There would be no difficulty in Wisconsin or Michigan getting their influence. Is not that your opinion, Mr. Whitaker?

Secretary Whitaker: I do not think there would. Did not this Society a year ago make some recommendations on this line?

Mr. Clark: Yes, there was a resolution passed.

Mr. Bowers: And, as I have just said, on the strength of it in my estimate to Congress I asked for an increase in the appropriation from ten thousand eight hundred to fifteen thousand dollars. But that is a small appropriation. It had been ten thousand eight hundred dollars for fifteen years past, as I understand it, and this is the first year we have had as much as fifteen thousand dollars for this purpose. It is inadequate. It should be twenty-five thousand dollars. In the recommendations to be made by me in October, I am going to ask for twenty-five thousand dollars, and yet, on the other hand, if some of the representatives on the great lakes should ask for an appropriation for the establishment of a laboratory, it might possibly be got through in addition to the appropriation for scientific inquiry.

Mr. Clark: Special, do you mean?

Mr. Bowers: It would go in the sundry civil bill, you understand. It would be necessary to have a resolution passed authorizing the Commissioner to make the requisite investigation to determine on the location, and, really, we should have two laboratories, one on the coast of Florida and one on the Great Lakes.

Mr. Reighard: The sum you speak of, fifteen thousand, is the total available?

Mr. Bowers: For all purposes. At present we are running virtually three laboratories out of fifteen thousand dollars; one at Woods Hole, one at Beaufort, North Carolina, and one at Put-in-Bay. The amount is fixed by Congress. The statistical inquiry is given five thousand, whilst propagation and fish culture is given one hundred and fifty thousand. Of course, we have thirty or thirty-five stations to operate with that, and expenses of all kinds must be paid from that source.

This paper of Professor Reighard's gives some valuable information that would be useful to our commission, and I suggest, in view of the fact that it would be necessary to make a recommendation to the Secretary of the Treasury by the first of October, that I be furnished with a copy of his paper at the earliest possible moment.

Mr. Clark: I would suggest, that as soon as it comes to the Secretary's hands, he have a typewritten copy made and send it to the Commissioner. Ordinarily it has been the policy of the Society not to give out papers, but in this case the circumstances are different.

Mr. Bowers: I assure you I shall do everything in my power to bring about the recommendations made in Professor Reighard's paper. I am just as anxious to have a laboratory on the Great Lakes as any individual member of the American Fisheries Society, and you shall have my active co-operation and the support of the Fish Commission in these matters.

Mr. Parker: I suppose the paper read is a document of the Society, and I would move that it is the sense of the meeting that a copy be type-written and forwarded to the Commissioner of Fisheries; that the Secretary be authorized to have such a copy made.

The motion was duly seconded and carried.

Secretary Whitaker then read the following paper by Mr. Fred Mather:

THE GAMMARUS OR FRESH WATER SHRIMP AS TROUT FOOD.

BY FRED MATHER.

When I began breeding trout, something over thirty years ago, the gammarus was thought to be an all-sufficient food for trout of all sizes, and a beginner was advised to stock his streams with them and then watch his trout grow. This idea still prevails to a great extent, and because I do not value the gammarus as highly as formerly, this paper is written.

Trout from two to six months old live largely on the larvæ of the many species of water breeding insects, together with small crustaceans, such as gammarus, asellus, cyclops, etc., as well as mature insects. Such small food is quite "filling" for a troutlet, but a yearling is not entirely satisfied with such small morsels, and adds snails and small fish to its menu. When our trout is two years it looks for larger things, although a few flies, by way of dessert, are still alluring, while very large trout seldom rise for flies.

Last winter I wrote a book which is now being printed by *Forest and Stream*, entitled "Modern Fish Culture in Fresh and Salt Water, with chapters on the culture of Whitefish, by Hon. Herschel Whitaker, and on the Wall-Eyed Pike, by James Nevin." Perhaps a quotation from the chapter on natural foods for trout will cover my views on this subject. I have said:

"If the fish are to forage for the whole or part of their food, the pond should be stocked with such water plants as grow in spring water, and then the crustaceans, gammarus and asellus should be introduced. But beware of the burrowing crawfish, for it not only enters into competition with the trout for its crustaceans and insect larvæ, but makes holes in dams. Besides this, it cannot be eaten by small trout when it is in the adult state, and when soft it hides. The gammarus is usually called 'fresh-water shrimp,' while the asellus, or 'water asel,' looks somewhat like the 'sow-bug' found in decayed wood. In some waters these crustaceans grow to the length of three-quarters of an inch, but usually they are smaller. Trout also eat newts or salamanders as well as snails, both the spiral and the ramshorn. Insect larvæ will be apt to breed in the ponds without being especially introduced. The gammarus is greatly over-rated as a trout food. A few are eaten, but not in the proportion that is usually thought. My searching of stomachs of wild trout under two inches long showed, under the microscope, that cyclops and Daphnia, two minute forms, barely visible to the naked eye, were the most plentiful.

"On Wilmurt Lake, situated on top of a mountain in Herkimer county, N. Y., where no fish but brook trout live, I opened the stomachs of 247 trout that had been dressed for the table. No microscope was at hand and there was much that could not be identified. From what was distinguishable a rough estimate was made. It was: Insects and their larvæ, 80 per cent; newts, 15; gammarus, 5.

"At Meacham Lake, Northern Adirondacks, the result from 138 stomachs was: Insects and larvæ, 60; newts, 5; gammarus, 5; fish, 30. Therefore, I feel warranted in ranking the gammarus low in the list of trout foods. Still, it has a value. Trout of a pound weight seldom eat it."

Since the book was written I have examined but few trout stomachs, but hope to continue the investigation. I am now in the northwestern county of Wisconsin, on the famous Brule River, where trout once swarmed, and a few are left; the aquatic fauna seems to be scant in species, although numerous in individuals, but I have been too busy to study it. The gammarus is reported to be found here, but I have not met it.

DISCUSSION OF MR. MATHER'S PAPER.

Mr. Clark: Mr. President, I do not agree wholly with Fred Mather. However, I shall not fill the book with any discussion in opposition to Mr. Mather, because he is not here; generally when he is we have a time, but I think the gammarus is a valuable food for trout, and I think that I can prove it right in Northville. I gave a little statement last year in regard to five thousand brook trout fry that were put in our spring pond, and the gammarus is the principal food of the spring. The trout lived four months without any artificial food. All the food they had was the life that was in the water, and the gammarus was the principal thing. They were put in the spring pond the first of June and in October they were taken out. And they actually counted thirty-six hundred and a little over of as nice, healthy trout as I ever saw.

Mr. Titcomb: Mr. President, I have not much to contribute on the subject of this paper, but in Vermont no self-respecting trout will eat a newt; they will eat the leach, the blood-sucker, but we have trout ponds stocked with trout where natural food is scarce, where the fish do not attain a large size on account of the lack of food, and the same ponds are teeming with newt. I have never found a newt inside of a trout. I have been aware they would occasionally eat them. I am surprised that they would in some places where they have so much other food, like the insect larvæ. As to the gammarus, I have very little experience except in some observations made in the commercial trout hatcheries of Mr. Gilbert at Plymouth. He has rather a crude station; that is, he has not kept up with the times in fish culture, perhaps, but in some ways he has accomplished a good deal with natural food. His ponds are teeming with the gammarus and the banks of the streams flowing into the ponds are teeming with the gammarus. You take a sod out of the banks anywhere and lay it down on the walk and it is alive with them. He claims that he gets a finer colored fish and a better flavored fish by getting so much natural food, and that his trout artificially reared can not be distinguished from the wild trout. He cooked some for me and I could not see but that they were just as good as the wild trout which I take out of the streams of Vermont. But certainly a large number of the fish were dependent upon the gammarus to sustain life.

Secretary Whitaker: I suppose there could not well have been much difference in the fish if the food was the same as the wild trout.

Mr. Titcomb: I do not suppose there could. He had really imitated natural conditions very closely.

Secretary Whitaker then read the following paper:

SOME NOTES ON THE MONTANA GRAYLING.

BY DR. JAMES A. HENSHALL.

My paper on the Montana grayling, read at the last meeting of the Society, contains some statements obtained at second hand which I wish to modify. My assistant engaged in collecting grayling eggs at Red Rock Lake, Montana, reported to me last season that the eggs when first extruded were quite adhesive, causing them to form in bunches, soon followed by a rapid development of fungus, which caused the death of the egg. When the eggs were received at Bozeman station they were clear, crystal white in color, which I gave as the characteristic hue.

I found this season, from personal observation, that the eggs when first extruded were of a rich yellow color, owing to the large oil drop, which renders them almost semi-buoyant; but after a few days of incubation they became quite pale. I also discovered that when first extruded the eggs were not at all adhesive, but if not exposed to a pretty strong pressure or current of water after fertilization (instead of being placed in the ordinary manner on flat trays), fungus soon formed, with the consequent adhesiveness and bunching of the eggs. This season we employed the hatching jar and the Stone-Williamson basket trays, instead of the flat tray, and had no trouble with fungus or bunching of the eggs, although we had but two feet fall of water from the reservoir trough. This proved the prediction made in my paper last year, that the eggs should be subjected to a strong current or pressure of water to obtain the best results; and this can be accomplished by the use of the hatching jar or the Stone-Williamson basket tray.

The grayling embryo is so active and lively, and the egg so buoyant, that there is a constant tendency to its floating off from the ordinary flat tray. This method is, however, still employed in England. In a letter recently received from Mr. Andrews, of the Surrey Trout Farm, Haslemere, England, he says:

"We find it an advantage when spawning the fish (grayling) to avoid shaking the eggs in the pan more than we can possibly help—we usually spawn the fish direct into the perforated zinc trays (standing in the pans), in which they are to be hatched, and then after milting them and adding water we let them stand until they are ready to go into the hatching boxes.

"The tray with the eggs in it is then lifted out of the pan and placed in the hatching box. If very much fluid comes away from the female with the eggs, we drain this off before we add the milt from the male, and the water.

"Our hatching water is about 49° F. in temperature, and does not vary more than $\frac{1}{2}$°. In this temperature the average time of hatching is about 22 days after being laid down, or half the time of trout ova. The alevins lose the sac very quickly, and at the first signs of feeding we sprinkle dry floating food, which we obtain from the dog biscuit manufacturers, on the water in the hatching trays, and they take this readily.

"After feeding for two or three days, and when they are taking the food well, we remove the fry from the hatching trays to a rearing box, where they are fed for about ten days in a similar manner, but they have in addition about two feeds a day of very finely chopped meat. We then turn the fry out into shallow ponds with a good stream of water running through them, or shallow streams; in all of these we have an abundance of natural food: shrimps, snails and minute crustaceans, water fleas, cyclops, etc. After turning out into these ponds and streams we do not feed more than twice a day with artificial food.

"We find grayling *much* more difficult to rear than trout; and in this country waters which suit trout do not always suit grayling."

The eggs of the Montana grayling hatch in from 10 to 15 days in water of about 50° F.; and in shipping the eggs after the eye-spots appear, some will hatch en route if the temperature rises above 40°. For shipping long distances they should be placed in refrigerator cars or a specially devised shipping case prepared, whereby the temperature can be kept at 40° or a few degrees below. I shall endeavor to design such a case for future shipments to long distances.

All of our grayling eggs are subjected to a wagon haul of fifty miles over rough spring roads before reaching the express office—an untoward circumstance that can not be avoided at present.

We find that the liver or meat diet, in a fluid state, as used for trout fry, is the best also for grayling fry. Our newly hatched fry will not take dry floating food, as recommended by Mr. Andrews. We have tried baker liver ground very fine and the fine fish cake, but they refuse to notice either, though they will take it after being taught to feed on liver emulsion.

The proper systematic place for the Montana grayling has not yet been definitely settled. During the past year the name *ontariensis* has been relegated and the former name *tricolor* has been restored, so that the present name of the Montana grayling is *Thymallus tricolor montanus* (Milner). Jordan & Evermann say it is: "Entirely similar to the Michigan grayling, but the dorsal a little smaller." This I can not subscribe to, as from examination of a large series of specimens this spring I find the Montana grayling to be as closely allied to the description of the Arctic grayling (*T. signifer*) as to the Michigan form (*T. tricolor*), as the annexed table may show:

SPECIFIC CHARACTERIZATIONS OF THE AMERICAN GRAYLINGS.

	T. signifer.	* T. tricolor.	T. t. montanus.
Head in length	5½	5	5
Depth in length	4⅔	5½ to 6	4½
Eye in head	3		3⅓
Maxillary in head	6		3
Scales	8–88 to 90–11	93–98	8–82 to 85–10
Gill rakers	12 below angle		5+12
Dorsal rays	24	21–22	18–21
Height of dorsal	3½ in length	Moderate	4½ in length
Spots on body	Anterior	Posterior	Anterior

* Not having the full description of *T. tricolor* at hand will account for the omission of some points in above table.

The color of the Montana grayling is as follows: back, gray, with purplish reflections; sides, lighter, with purplish and silvery reflections; belly, pure white; a few V-shaped spots from middle of dorsal fin to gill cover, but none posteriorly; two oblong black blotches in cleft between opercle and branchiostegals, more pronounced in the male; a dark heavy line on upper edge of belly, running from ventrals to pectorals in male, very faint in female.

Dorsal fin edged with a red or rosy border; six or seven rows of red or rosy, roundish spots, ocellated with white; dark blotches forming lines between the rows of red spots; in upper, posterior angle there are several larger oblong rosy spots. Ventral fins with three rose-colored stripes along the rays. Pectoral and anal fins plain.

DISCUSSION OF DR. HENSHALL'S PAPER.

Mr. Clark: In reference to the work Dr. Henshall is doing there, I wish to state that a case of these eggs was forwarded this year to the station of which I have charge. They were billed to me as fifty thousand eggs. They came the forepart of June, probably the 10th, a very warm time, and they were nicely packed with an ice tray. The loss on these eggs was quite considerable, I should presume ten per cent. Some of them had hatched and died, but after they were thoroughly sorted out they measured up about sixty-seven thousand. They were said to be fifty thousand when they were sent. That is something remarkable, because fish culturists sometimes ship less than they count out on arrival at destination. I feel well assured that this is going to be a valuable work of the United States Fish Commission. I immediately wrote Washington after carrying them along until the time of distribution, and praised the work highly, and recommended that next year at least five hundred thousand be forwarded to the Northville station. Mr. Ravenel informs me that if the money is available they will send us all we want. The Montana grayling fry are very much different from the fry hatched from the eggs of Michigan grayling. They do not act the same in the troughs at all. After hatching, they settle on the bottom of the trough the same as trout fry. The fry hatched from the Michigan grayling about fifteen years ago at our station are free swimmers, the same as a white fish; but in the case of the Montana grayling they lie on the bottom of the trough from twenty-four to forty-eight hours before they begin to swim. Then they begin to swim, and of course the sac is absorbed in a very few days, about six or eight days; between the sixth and eighth day they begin to take food. We have them there now. and if you could take a look at them you would see them under different conditions from what you did those at the Omaha Exposition last year. So far they are doing very finely, very nicely indeed; but whether we are to succeed in raising many of them or not I can not say as yet. They are taking food. We are feeding them finely chopped liver.

President Peabody: Would you advise putting grayling in a stream where there are brook trout?

Mr. Clark: Well, you cannot hurt the brook trout any, but it is a question, of course about the grayling.

President Peabody: Whether you would waste your grayling or not?

Mr. Clark: Yes, whether you would waste your grayling or not. I have planted half of these in the Au Sable River and half in the Pere Marquette River, two old grayling streams, both having brook and rainbow trout now.

President Peabody: In regard to the temperature, a stream that is too warm for brook trout is all right for rainbow trout. How is it about the grayling?

Mr. Clark: We can keep them in ponds in the warmer water, if we have plenty of it. Mr. Stone informed me that Dr. Henshall, when he sent these on, advised that we be sure and hatch them in creek water, and keep them in creek water. We did not hatch them in creek water and we are not keeping them in creek water, because our creek water is not so clear and nice as our spring water. His idea was that we could not hatch them in our spring water.

Mr. Titcomb: As I understood it, the question was whether the grayling would survive in warmer water than our brook trout?

President Peabody: That is it.

Mr. Titcomb: I understand they require cold water. The cold, swift mountain streams of Montana are their natural habitat, and also some of the cold water lakes. These eggs Mr. Clark received came from the station, I presume, from which I received some, and were taken in what is called Red Rock Lake.

Secretary Whitaker: In answer to a question put by the President to Mr. Clark, I want to say that in my opinion there is no difficulty about grayling and trout living in harmony, at least such is disclosed to be the fact by the literature in England upon the subject from Francis and Walton down to the present day. There they are found in the same stream. So far as the temperature of the water is concerned I know nothing about it further than the character of the streams where they are found in Michigan. They are cold spring streams, and some of the best results obtained in trout culture in the United States have been had in old grayling streams. They do not inhabit streams south of a belt stretched some twenty or thirty miles north of Grand Rapids, diagonally northwest and southeast across the state. They are not indigenous to the streams below that line, so far as my knowledge goes.

President Peabody: They practically require the same water as brook trout.

Secretary Whitaker: Oh, yes.

Mr. Titcomb: May I inquire how you account for the disappearance of the grayling in your trout waters?

Secretary Whitaker: I have had occasion to refer to that in our reports three of four times, and there is no question that it is due to the lumbering operations in our state.

President Peabody: Are the trout similarly affected?

Secretary Whitaker: No; the spawning season of the grayling is later. During the winter the streams are filled with logs, and when the ice passes out in the spring, which is before the grayling eggs have hatched, they destroy the beds and kill the ova.

Mr. Parker: The spawning habits are entirely different. The trout spawns on the gravel and the grayling on the sandy ridges.

Secretary Whitaker As it is getting late, I move that the paper of Mr. Meehan be read by title.

The motion was seconded and carried.

OBSERVATIONS ON THE MORTALITY AMONG TROUT FRY AT THE ALLENTOWN HATCHING STATION THROUGH LONG INBREEDING.

BY W. E. MEEHAN.

On the twenty-fifth of February of the present year, the Pennsylvania Fish Commission had in its troughs at the eastern hatching station, near Allentown, 2,200,000 brook trout fry, 30,000 California trout fry, 8,000 brown trout fry, and 250,000 Atlantic salmon fry. Within two weeks thereafter the entire lot of little fish, except the Atlantic salmon, were all dead. To the superficial observer, the fry were in normal condition of health on the first of February, but to the practiced eye of the Superintendent all was not right with them from the time of hatching, although not alarming enough to make a formal report to me as the State Statistician of Fisheries.

When February was about half gone, the State was visited by a terrific blizzard, such as had not been experienced for many years. During it the far end of the lower hatching house was hove up about three and one-half inches by the frost. This caused the water in the hatching troughs to rise and back even to the farther troughs of the upper house. By the time this was discovered and the flow-cocks regulated, a thaw set in and the lower house sank back nearly to its original position, and disarranged the proper water supply again.

Almost immediately on the disarrangement of the water supply the disaster began. All the fry except the salmon began to huddle at the upper end of the troughs about the inflow and to exhibit marked signs of distress. A week later the Atlantic salmon fry and about ten thousand wild trout showed some similar signs. In each trough were from twelve to fifteen thousand trout, and these crowded themselves in a space of a little more than a foot and a half square. Nothing could disperse them. A feather or the hand thrust among them would simply turn the little creatures over and over without resistance on their part. Within a few days they began dying at the rate of from one hundred thousand to over two hundred thousand a day, and this continued until all the cultivated trout fry were dead. The wild trout fry subsequently died also, except about a thousand or two thousand. The Atlantic salmon recovered, none having died, and, when planted, were apparently fine, healthy fish.

As soon as the trouble began the Superintendent notified me and I began an investigation, and I soon became convinced that the trouble was caused primarily by a low vitality among the fry, due to too long continued inbreeding, and immediately to an insufficient amount of oxygen in the water on account of a vast amount of melted snow flowing in the spring, and to some extent by over-crowding in the nursery troughs.

It transpired that new blood had not been infused into the breeding stock for nearly seventeen years. This, it appears, was not altogether the fault of the Superintendent, because on at least two occasions he had made application for a change of blood, and about a year ago, shortly after my appointment as State Statistician of Fisheries, he had informed me of this fact and made application for wild eggs (which I secured him), and expressed his fears lest there would be trouble because he had not received the new blood previously asked for.

My investigation showed that the weather last fall was favorable to the hatching of all species of trout at the Allentown station. This was equally true as regards the water, although flowing from a gravel or disintegrated rock spring which has less aeration than one flowing from a limestone formation. The brook trout hatched in from forty to forty-two days, and appeared at first in a fairly satisfactory condition, except that they were under the normal size. The growth was then observed to be unusually slow, and they were fully fifty days in absorbing the sac. They were also very sluggish in their movements, which were only partially corrected by salt baths. Their sluggishness was also markedly noticeable during the feather washing. Instead of moving about in a lively manner when this was done, they would scarcely move at all, and, in fact, allowed themselves to be pushed about without resistance. Suddenly another change took place. The fry often became overactive, very excitable and wild, and showing great signs of fear. The little fish, perhaps sluggish and apathetic a moment before, would suddenly snap at anything floating in the water and seemed to be consumed with hunger, although they received an abundance of food. They even ate their own excrement, and this, instead of being of a healthy black color, was white, showing that the food given passed undigested through the stomach. The fish were also thin, as though half starved. The gills were whitened and apparently without blood.

It was not until the snow water began flowing into the spring and from thence into the troughs, that the fry began to huddle under the inflowing water and exhibit every sign of not having sufficient oxygen, but while, as an experiment, additional oxygen was supplied in some of the troughs by providing additional inflows and artificial aeration, the most that could be done was to break the huddling into as many groups as there were inflows. The artificial aeration seemed to have very little effect. Confinement in well aerated water outside the house was also tried without result.

The mortality began on February 26, on which day more than 50,000 died. Before March 1 over 350,000 were dead. In less than ten days thereafter there was not a single one of the entire hatching of eggs from the cultivated trout alive.

During the blizzard the wild trout fry showed evident signs of distress, but at no time to the same extent as the fry of the cultivated trout, namely, to huddle at one end of the trough. When they began to die, as they did at about the time the mortality of the others was past its height, it was with all the evidence of some well-defined disease, which attacked the gills, which disease I am inclined to believe was induced by the water being tainted by the other dying fish.

I am thoroughly satisfied that the original cause of the trouble at the Allentown station was due to too long-continued inbreeding, that the catastrophe was hastened by overcrowding the troughs and a sudden supply of unaerated water. Many premonitory things occurred during several preceding winters, for which other causes were assigned, but which afterward became cumulative evidence showing a steady lowering of vitality. For instance, the trout sent out from that station for five years back were abnormally small at the age of four months, very little larger, in fact, than the two months old fish hatched at the Corry or Western station. Moreover, there were more complaints during the previous three years of the number of dead fish from applicants than there were over the fish received from the Corry station. During the winter of 1897-98, more than half a million fry died at Allentown station. This mortality was ascribed at the time to the warm weather which caused the eggs to hatch in thirty days, producing weak fish, but which now we believe to have been but the precursor of the disaster which followed a year later.

The casualties at the Allentown station were so great and the matter was one of such widespread importance to fish culturists, that I felt that other judgment than mine should be given and other investigations be made. I therefore laid the matter before the United States Fish Commission when the trouble first openly manifested itself, and Commissioner Bowers decided to send Dr. Charles M. Blackford of Washington, D. C., to study it. This gentleman, who is making a study of diseases of fish, remained at Allentown for nearly two weeks, and his findings coincided with mine as far as the question of inbreeding is concerned, but he did not appear to think the catastrophe was hastened by unsuitable water conditions, but Dr. Blackford was, and is probably yet, unaware of a fact which only came to my knowledge a number of weeks later, namely, that out of some thirty thousand fry of the winter's hatching distributed in retaining ponds in a different part of the state, more than one third did not die, the holders of these fry merely contenting themselves with complaining of an unusually bad lot of fish, of which the greater number died and the remainder were very small. These persons were entirely ignorant of the mortality at Allentown. Thus it will be seen that while all the fish remaining in the Allentown troughs died, a proportion of those given other environments escaped the same fate. This to my mind is conclusive evidence that there was some other immediate cause for the sudden loss of the fish than low vitality, due to persistent inbreeding.

Dr. Blackford's report is exceedingly interesting and was made in duplicate to me for the Pennsylvania Fish Commission and to the United States Commission.

Dr. Blackford says in part:

"During the winter of 1898-99 approximately two million brook trout were hatched in the Allentown station. The ova are hatched on beds of gravel and wire gauze trays. * * * The water is brought into the houses by an open trough that extends the entire length of the buildings and is pierced by cocks that allow a regulated amount of water to flow into the shallow troughs in which the eggs are hatched. This arrangement allows the water to become aerated and enables the dead or fungoid eggs to be readily fished out. After hatching, the fry are retained in the hatching troughs. These troughs are of wood. * * * At the lower end of each trough a screen of wire gauze extends across it from side to side, and between this screen and the end of the trough is the outlet. * * * The fish from which milt and ova are taken are reared in the hatchery and are the descendants of those brought to this station when it was removed from Marietta.

"In 1898 the fish began spawning very early, and spawn was taken on October 3. The period of incubation was short, only 35 to 42 days, and the fry are small.

"The troughs containing the fry were scrupulously clean, no algae or growths of any kind being found in them. The fry were huddled about the upper end, crowding so thickly around the inlet that they concealed the bottom, except the place on which the jet of water fell. On touching the surface the fish seemed apathetic, not darting away as healthy fry usually do. Respiration was rapid and 'panting.' The fry took food languidly, though at times they snapped at it eagerly, but the food was not digested and the excreta was almost unchanged. The fish were very small. Although several months old, they were only about an inch long, and so weak that a slight increase in the flow of water would wash them away. They died in vast numbers; from 80,000 to 100,000 a day is not an overestimate.

"The fry are distinctly anaemic. They lack vitality and seem incapable of sustaining life. No fault of any kind can be found with the station or its management. On the contrary, the Pennsylvania Fish Commission is to be congratulated in its Superintendent. * * * The fault lies with the fish and not with the environment.

"So far as I am able to determine, there is no disease present. The gasping respiration is not accompanied with an inflammation of the gills and is due, in my opinion, to a lack of red blood corpuscles. A number of the fry were placed in a floating box with a wire gauze bottom and put in the race way that supplies the pond, in the hope that this water, which is better aerated than that in the house, might give relief, but no difference was observed.

"For fifteen years or more no new blood has been introduced, but steady inbreeding has been practiced. In some of the ponds are yearlings that appear to be healthy, but are small, and this small size may be due to a lack of fresh strain."

It might be noted that in Dr. Blackford's report he notes apparently what he regards as an unusual circumstance, namely, that the "fish began spawning very early, that spawn were taken on October 3." Apparently the Superintendent of the station failed to inform him that this is about the date on which the fish have for years been in the habit of beginning to spawn at this station, consequently this incident cannot be considered in studying the case. The trout at Allentown always spawn about a month earlier than at Corry, and it might not be uninteresting to note, although having nothing whatever to do with the subject, that while the California trout spawn in the Allentown ponds early in December, those in the Corry ponds in the western part of the state do not begin this function until March or April.

The loss of the entire hatching of trout fry at the Allentown station was a severe blow and a costly one as well, but it has taught us a lesson which we are not likely to forget in a hurry and which we are likely to profit by. From this out the blood in the Allentown ponds, and indeed in our other stations, will be changed every three or four years. As a last word, lest the query might be raised, it might be stated that the fry in the Corry station are perfectly healthy and normal sized fish. The blood of the breeders has been changed twice within ten years.

Mr. Prather: Mr. President, I desire to say a word in relation to one stream of water which we have in the state of Kentucky, although it may not be found upon the map. A number of gentlemen, 125 in number, the membership is limited to that figure, have leased the water of this stream. They call the organization the Ellerslie Fishing Club. Therefore I shall style the body of water as Lake Ellerslie. It covers 136 acres, with surface drainage, two small streams and a great many small springs running into it. It has a maximum depth of 46 feet and an average in our main reservoir of over twenty feet. In the summer it is about 60 degree Fahrenheit. Numerous weeds grow in the water and furnish abundance of food for the fish. We have large mouth black bass and some time ago German carp were put in the smaller reservoir, and now they are to be found occasionally in the lower or larger reservoir. Now, we find our trouble to be largely in the size of the crappie. It remains just about three or four inches long. It is rarely ever the case we catch anything larger. Sometimes we catch a new-light or crappie two and a half pounds, but it is rarely the case. I want to find out something that would be good food for these fish.

Mr. Titcomb: Do you have the smelt?

Mr. Prather: What is that?

Mr. Titcomb: I cannot give you the scientific name. It is a small form of white fish. In some waters it never attains a length of more than five inches; in other waters it will attain a length of eight or ten inches; and we value them as a food fish also; but we introduce them in our New England waters. They are food for the salmonidae more particularly. They are in the lakes where we introduce the land-locked salmon. They increase very rapidly. They spawn by ascending the small tributaries to the lakes, and in summer they inhabit the deep waters of these lakes and furnish an abundance of food. In fact, the chief complaint we have had in New England, and I think all the New England states have encountered it, is that these smelt increase so fast that the game fish are satiated and do not take the lure of the angler so freely as they did before the smelt were introduced. The smelt can be introduced in the form of eggs. We have been more successful in introducing the fish themselves, where we can get them easily and transport them; but the fish spawn on bushes and shrubs and leaves in the water, or on gravel, and can be taken out bodily on branches to which the eggs adhere, boxed up in lots and shipped and placed in any other stream where it is wished to introduce them. They then hatch out naturally and go on their way rejoicing. They will furnish food for your bass in time. At the same time there is a good deal of discussion about them.

Mr. Prather: Do you think it would do for us to have fresh water shrimp introduced as food?

Mr. Titcomb: You might be successful with them, and might not. In some places I have introduced them, and in other places I have been unsuccessful. I am unable to say to what waters they are best suited. I think the gentleman from Montana has described a lake where the smelt would thrive.

President Peabody: Alluding to carp, Mr. Ravenel stated to some of us last night that the carp had furnished food for the crappies and bass.

EXHIBITION OF MODEL OF FISH-LADDER, BY DR. J. C. PARKER, WITH REMARKS.

President Peabody: Dr. Parker has a matter which he wishes to bring before the convention, and has a model which he will show you with his explanation.

Mr. Parker: I will just say a word about the perennial question of fish-ladders, and that there are ladders and ladders. I will just show you the features of this invention. In this representation I intended to have a full working model, but failed to get it out for want of time. The idea is to have a trap made just as you would have a pound net, with a leading line leading up as I show you here. The construction of it is such that this would always be above the highest stage of water. My idea would be to have it all enclosed and the frame drop right down in so that it can be taken out at any time and cared for. You can use any power that is available. Of course, during the time of the running of the fish there would have to be an attendant, but until those things are tried the real practical side of it has yet to be determined. That is about all I have to say, and I just exhibit this to the Society. You are not limited as to the height. You can have it any height you desire. It is only a question of the length of chain you use. I think it can be made very cheaply so far as the question of expense is concerned. By the time another meeting is held I shall have one in active operation.

Secretary Whitaker: It strikes me that there is an advantage in that device over any other. You would not necessarily have to cut an opening in the dam?

Mr. Parker: Not at all.

Secretary Whitaker: That would overcome one of the most serious objections. It weakens a dam to put in these structures.

President Peabody: Have you succeeded in having any fish ways put in operation in your state?

Secretary Whitaker: Yes; we have had them for thirty years, but they are not successful.

Mr. Titcomb: I would like to ask the Doctor if he has taken into consideration the location of that pound net. These fish run, ordinarily, when the water is high and an ordinary pound net or almost any form of weir below the dam where you have to use the fish way, is going to be washed out.

Mr. Parker: I will give you my idea, that two or three feet high, diagonally across the stream, you put in something made of slabs and the force of the water will hold it there.

Mr. Titcomb: Does it not clog?

Mr. Parker: It does not matter about clogging. The water goes over it and the fish come under it. It can not clog on the under side.

Mr. Titcomb: Our dams have logs three or four feet in diameter going over them.

Mr. Parker: But this will not be over two or three feet high in the bottom of the river, and your flood wood, etc., during the time that your fish are running, would most generally be above the top of that. That is a practical thing which has been carried out in our river. They have put in booms in that way, and they are there today, little abutments like. It looks to me as if this would solve that very much vexed question of how to get the fish over the dams.

Secretary Whitaker: There is no reason why the State should not pass a law providing that in the construction of any new dam, whether it is an original, new construction or built to take the place of one swept away, the owner should be compelled to put in a chute. In the course of twenty years generally speaking, you would thus have chutes in a majority of the dams of the State. In the course of time dams grow weak, and they go out and have to be renewed, and in that way you could get his done where otherwise there would be too much opposition.

Mr. Titcomb: That is the way we are endeavoring to overcome the sawdust question in our State. That all new mills shall take care of their sawdust, and as the old ones are gradually retired, we will eventually get our streams purified.

Mr. Clark: I would like to say one word in regard to this fish way. In the early days of the Fish Commission I was at Holyoke, Mass., and one of my duties was to look at the fish-way there and see if the shad ran up. Mr. Brackett, I think, the patentee of the fish-way, visited that station several times, and I told him that the shad did not go up the fish-way. There were plenty of shad at the mouth, but they did not ascend. He said, "If you will stand here with a net and catch those shad they will go up." I tried it and caught a few and put them in and they went up. Now, the Doctor has solved that problem for the shad, if it will do what he claims. The shad did come up to the foot of the fish-way, but would not enter it. The Doctor has something here that will force them to enter it.

Mr. Parker: Yes; if anything will solve the shad question, that or something similar to it will surely do so.

On motion duly seconded the Convention adjourned.

TREASURER'S REPORT.*

42 New York Street, N. Y., June 26, 1898.

To the American Fisheries Society:

Gentlemen—I herewith submit my annual report as Treasurer, from July 15, 1898, to June 26, 1899:

July 15, 1898, balance in hands of Treasurer..........		$401 26
Receipts of.........1895, dues	$1 00	
" " 1896, "	3 00	
" " 1897, "	9 00	
" " 1898, "	120 00	
		133 00
		$534 26

DISBURSEMENTS.

1898, Stenographer's bill, (Voucher A).....	$55 00	
" Postage to September 30.............	4 08	
" July printing, 250 Treasurer's receipts, (Voucher D).....................	2 75	
" July printing, 250 envelopes, (Voucher C).............................	1 50	
" October postage.....................	1 06	
" November postage..................	1 16	
" November, Speaker Co. printing reports, (Voucher B).....................	134 65	
1899, January printing, 250 envelopes, (Voucher E).....................	1 50	
" Typewriting........................	1 20	
" Disbursements by Secretary, as per his account, herewith attached as (Voucher F)............................	32 62	
" June 20, 1899, postage from December, 1898............................	3 78	
" Discount on out town checks........	40	
		239 70
June 26, 1899, balance in hand for 1898.........		$294 56

Yours respectfully,
L. D. HUNTINGTON,
Treasurer.

* (On account of sickness the Treasurer was unable to attend the meeting. His annual report was, however, forwarded by express to Secretary Whitaker at Niagara Falls, but was not delivered. Subsequently it was learned that the package containing the report and vouchers arrived in ample time for presentation at the meeting, but was mislaid through the carelessness of a hotel employé. Later the papers were returned to the Treasurer, who forwarded them to the present Secretary. President Titcomb then appointed Mr. Frank N. Clark as a Committee of Audit to examine the accounts. *Seymour Bower, Secretary.*

I hereby certify that I have examined the foregoing account, with accompanying receipts and vouchers, and find the same to be correct. I recommend that the report of the Treasurer be accepted and adopted.

(Signed) FRANK N. CLARK,
Committee of Audit.

SUPPLEMENTARY REPORT OF TREASURER.

I take the liberty of submitting briefly as supplementary to above annual report some subject matter that may be interesting to such members of the Society as may be present at the 28th annual meeting. It will be seen by the Treasurer's report that there is a reduction in the balance for the year of $106.70; balance in treasury at time of last annual meeting being $401.26, while present balance is $294.56. This was caused by the reduction of yearly dues last year from $3 to $1. Unless the membership is greatly increased or the dues are raised again the treasury will soon become depleted. I have looked over the annual reports of the Treasurer from 1881 to date. I find at the commencement of the year 1881 there was a deficit of $131.70 in the treasury. The total receipts from 1881 to date (19 years) were $4,957, while the disbursements for the same period were $4,530. Add to the disbursements the deficit of $131.70 (due to balance the treasury) makes the total disbursements equal, $4,661.70—leaving a balance of $295.30, which virtually represents the present balance in the treasury. During this period the yearly average membership was 167, the least number of members being 121 for year 1884; the highest, 250 for year 1894; the annual dues during the period being $3, except for the year 1898, when it was $1; the yearly average receipts being $260.88; the disbursements $245.35, being a yearly average of $15.53, excess of receipts over disbursements. There are now on the list of members revised for use of the Secretary for the coming report (of 1899), 160; members with dues paid in full to date, 120; members owing one year's dues, 15; members owing two years' dues, 12; members owing three or more years' dues and liable to be dropped from the list under article two of the constitution for non-payment of dues, 13. Have dropped no names from the list for non-payment of dues this year, hoping to be able to collect the dues of some of them. While some of the thirteen have taken no notice of the four requests made of them the past year, others have made promises to pay soon as they could. There was a membership of 136 as revised and reported to the Secretary last year. The Secretary has reported to me the names of 28 new members for the year 1898, one of whom, Mr. J. E. McLeed, of Milwaukee, I have been unable to find; therefore his name does not appear as a member. The Society has lost three members during the year; two, Mr. T. W. B. Hughes, of New York City, and Samuel Wilmot, of New Castle, Ontario, by death, and one, Mr. E. G. Whitaker, of New York, by resignation, whose resignation should be accepted by this meeting, leaving present membership at 160.

Respectfully submitted,
L. D. HUNTINGTON,
Treasurer.

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.

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.

LIST OF MEMBERS.

ACTIVE.

'92. Adams, E. W., 114 Wall st., New York.
'93. Alexander, L. D., 50 Broadway, New York.
'98. Alexander, G. L., Grayling, Mich.
'92. Anderson, J. F., 240 Eleventh st., Jersey City, N. J.
*Annin, James, Jr., Caledonia, N. Y.
'84. Atkins, Chas. G., East Orland, Me.
'92. Ayer, F. W., Bangor, Me.
'98. Babbitt, A. C., Williamsburg, Mich.
'98. Ball, E. M., Leadville, Col.
'91. Babcock, C. H., Rochester, N. Y.
'98. Barrett, W. W., Church's Ferry, N. D.
'86. Bartlett, Dr. S. P., Quincy, Ill.
'97. Bell, Currie G., Bayfield, Wis.
*Belmont, Hon. Perry, 19 Nassau st., New York.
*Benkard, James, Union Club, New York.
'99. Benton, W. H., Bullockville, Ga.
'84. Bickmore, Prof. A. S., Am. Museum Natural History, New York.
'97. Birge, Prof. F. A., Madison, Wis.
'86. Bissell, John H., Detroit, Mich.
'86. Booth, A., cor. Lake and State sts., Chicago, Ill.
'90. Bower, Seymour, Detroit, Mich.
'99. Bowers, Hon. George M., U. S. Comm'r of Fisheries, Washington, D. C.
'92. Bowman, W. H., Rochester, N. Y.
*Bottemanne, C. J., Bergen op Zoom, Holland.
'99. Brewer, W. C., Cleveland, O.
'92. Bradley, Dr. E., 19 West Thirtieth st., New York.
'98. Brown, George M., Saginaw, Mich.
'92. Brush, Dr. E. F., Mount Vernon, N. Y.
'97. Bryant, E. E., Madison, Wis.
'97. Bulkley, H. S., Odessa, N. Y.
'98. Bumpus, Prof. H. C., Providence, R. I.
'84. Cary, Dr. H. H., Lagrange, Ga.

*Admitted to membership prior to 1881.

'84. Cheney, A. N., Glens Falls, N. Y.
'84. Clark, Frank N., Northville, Mich.
'81. Crook, Abel, 99 Nassau st., New York.
*Crosby, H. F., 30 Broad Street, New York.
'99. Curtis, J. M., Cleveland, O.
'95. Dale, J. A., York, Pa.
'95. Davis, Palmyra, N. Y.
'97. Davis, George B., Utica, Mich.
'93. Davis, Horace W., Grand Rapids, Mich.
'94. Demuth, H. C., 144 E. King st., Lancaster, Pa.
'96. Dickerson, F. B., Detroit, Mich.
'99. Dinsmore, J. H., St. Johnsbury, Vt.
'94. Douredoure, B. L., 103 Walnut st., Philadelphia, Pa.
'99. Downing, S. W., Stone, Oregon.
'89. Doyle, E. P., Port Richmond, N. Y.
'94. Ebel, Hon. F. W., Harrisburg, Pa.
'85. Ellis, J. F., U. S. Fish Commission, Washington, D. C.
'96. Emerick, H. F., San Francisco, Cal.
'97. Fox, J. C., Put-in-Bay, O.
'99. Filkins, B. G., Northville, Mich.
'89. Friesmuth, E. H., Jr., 151 North Third st., Philadelphia, Pa.
'95. Frothingham, H. P., Mount Arlington, N. J.
'92. Gavitt, W. S., Lyons, N. Y.
'99. George, Hon. A. F., Swanton, Md.
'98. Griffith, S. L., Danby, Vt.
'90. Gunckel, J. E., Toledo, O.
'89. Hagert, Edwin, 32 North Sixth st., Philadelphia, Pa.
*Haley, Caleb, Fulton Market, New York.
'92. Hamilton, Robert, Greenwich, N. Y.
'95. Hansen, G., Osceola Mills, Wis.
*Harris, J. N., Fulton Market, New York.
'89. Hartley, R. M., 627 Walnut st., Philadelphia, Pa.
'84. Henshall, Dr. J. A., Bozeman, Montana.
*Hessell, Dr. Rudolph, 1209 Eighth st., Washington, D. C.
'96. Hill, John L., 115 Broadway, New York.
'95. Holden, H. S., Syracuse, N. Y.
'92. Hoxie, J. W., Carolina, R. I.
'97. Hunsaker, W. J., Detroit, Mich.
'91. Huntington, L. D., New Rochelle, N. Y.
'95. Hurlbut, H. F., East Freetown, Mass.
'84. Hutchinson, E. S., Washington, D. C.
'99. Hughes, Frank L., Ashland, N. H.
'89. James, Dr. B. H., n. e. cor. Eighteenth and Green sts., Philadelphia, Pa.
'95. Jennings, G. E., Fishing Gazette, 203 Broadway, N. Y.

*Admitted to membership prior to 1881.

'93. Jones, Alexander, Erwin, Tenn.
*Johnson, S. M., Union Wharf, Boston, Mass.
'95. Jones, Dr. O. L., West 72d st., New York.
'85. Kauffman, S. H., Evening Star, Washington, D. C.
*Kelly, P., 346 Sixth ave., New York.
'99. Kerr, T. R., Pittsburg, Pa.
'99. Kiel, W. M., Carolina, R. I.
'96. Kilburn, F. D., Albany, N. Y.
'98. Leach, G. C., 3923 Finney ave., St. Louis, Mo.
'98. Lydell, Dwight, Mill Creek, Mich.
'84. McGown, Hon. H. P., 108 Fulton st., New York.
*Mallory, Chas., Burling Slip, New York.
'99. Mancha, H. H., Northville, Mich.
'95. Manning, W. W., Marquette, Mich.
'82. Mansfield, H. B., Lieut-Com. U. S. Navy, St. Louis, Mo.
'97. Manton, Dr. W. P., Detroit, Mich.
'98. Marks, H. H., Sault Ste. Marie, Mich.
'98. Marks, J. P., Paris, Mich.
'99. Marsh, M. C., Washington, D. C.
'84. May, W. L., Omaha, Neb.
'94. Meehan, W. E., Public Ledger, Philadelphia, Pa.
'92. Merrill, F. H. J., State Museum, Albany, N. Y.
'84. Milbank, S. M., Union Club, New York.
'99. Merrill, M. E., St. Johnsbury, Vt.
'99. Miller, G. F., Put-in-Bay, O.
'99. Miller, W. S., Gallion, O.
'92. Mills, G. T., Carson City, Neb.
'99. Moore, C. H., Detroit, Mich.
'98. Morgan, H. A., Baton Rouge, La.
'92. Morrell, Daniel, Hartford, Conn.
'99. Morse, Grant M., Portland, Mich.
'99. Morton, W. P., Providence, R. I.
'96. Mosher, Stafford, Fort Plain, N. Y.
'96. Murdock, W. C., San Francisco, Cal.
'99. Mussey, George D., Detroit, Mich.
'96. Nash, Dr. S. M., 63 West 49th st., New York.
'98. Oberfelder, R. S., Sidney, Neb.
'97. O'Brien, W. J., South Bend, Neb.
'95. O'Hage, Dr. Justus, St. Paul, Minn.
'97. Osborn, Wm., Duluth, Minn.
'99. Orr, W. J., Bay Port, Mich.
'95. Page, P. W., West Summit, N. J.
'84. Parker, Dr. J. C., Grand Rapids, Mich.
'95. Peabody, G. A., Appleton, Wis.
'91. Post, Hoyt, Detroit, Mich.
'88. Powell, W. L., Harrisburg, Pa.

*Admitted to membership prior to 1881.

'92. Powers, J. A., Lansingburg, N. Y.
'98. Powers, J. W., Paris, Mich.
'92. Preston, Dr. G. H., 98 Layfayette Square, Brooklyn, N. Y.
'97. Preston, John L., Columbiaville, Mich.
'99. Prather, J. Hub, Lexington, Ky.
'89. Rathbun, Richard, Smithsonian Institution, Washington, D. C.
'96. Rathbone, Wm. F., D. & H. R. R., Albany, N. Y.
'93. Ravenel, W. de C., U. S. Fish Commission, Washington, D. C.
'98. Reighard, Prof. J. E., Ann Arbor, Mich.
*Ricardo, George, Hackensack, N. J.
'98. Richards, G. H., Boston, Mass.
'99. Roberts, A. D., Woonsocket, R. I.
'99. Robinson, W. E., Mackinaw City, Mich.
'98. Rogers, J. M., Chicago, Ill.
'99. Root, Henry T., Providence, R. I.
'98. Rosenberg, Albert, Kalamazoo, Mich.
'95. Rowinville, E. T., East Freetown, Mass.
'98. Ruge, John G., Apalachicola, Fla.
'97. Russell, Henry, Detroit, Mich.
'81. Schaffer, Geo. H., foot Beekman st., New York.
'92. Sherwin, H. A., 100 Canal st., Cleveland, O.
'99. Smith, L. H., Algona, Iowa.
'87. Spenceley, Calvin, Mineral Point, Wis.
'96. Steers, E. P., 2076 5th ave., New York.
'70. Stone, Livingston, Cape Vincent, N. Y.
'99. Southwick, J. M. K., Newport, R. I.
'99. Starbuck, Alexander, Cincinnati, O.
'98. Stelle, G. F., Chicago, Ill.
'99. Sterling, J. E., Crestfield, Md.
'99. Stewart, A. T., Northville, Mich.
'98. Stranahan, F. A., Cleveland, O.
'98. Stranahan, F. F., Cleveland, O.
'98. Stranahan, H. B., Cleveland, O.
'90. Stranahan, J. J., Put-in-Bay, O.
'89. Streuber, L., Erie, Pa.
'97. Sykes, Henry, Bayfield, Wis.
'99. Tawes, J. C., Crestfield, Md.
'99. Thayer, W. W., Detroit, Mich.
'97. Thompson, Carl G., 78 Henry st., Huntington, Ind.
'92. Titcomb, John W., St. Johnsbury, Vt.
'99. Tubbs, F. H., Neosho, Mo.
'98. Tulian, Eugene A., Leadville, Colo.
'92. Van Cleef, J. S., Poughkeepsie, N. Y.
'96. Walker, Bryant, Detroit, Mich.

*Admitted to membership prior to 1881.

'99. Wallett, W. H., Put-in-Bay, O.
'96. Walters, C. H., Cold Spring Harbor, N. Y.
'89. Walton, C. H., 1713 Spring Garden st., Philadelphia, Pa.
'98. Ward, Prof. H. B., Lincoln, Neb.
'92. Webb, W. Seward, 44th st. and Vanderbilt ave., N. Y.
'95. Weed, W. R., Potsdam, N. Y.
'86. Whitaker, Herschel, Detroit, Mich.
'96. White, R. Tyson, 320 Bridge st., Brooklyn, N. Y.
'89. Wilbur, H. O., 235 3d st., Philadelphia, Pa.
'99. Willard, C. W., Westerly, R. I.
*Willetts, J. C., 40 Wall st., New York.
'99. Williams, J. A., St. Johnsbury, Vt.
'99. Wilson, S. H., Cleveland, O.
'99. Wires, S. P., Duluth, Minn.
'92. Wetherbee, W. C., Port Henry, N. Y.
'97. Wood, C. C., Plymouth, Mass.
'99. Zalsman, Philip G., Paris, Mich.
'92. Zweighalt, S., 104 West 71st st., New York.

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*Admitted to membership prior to 1881.

PROSPECTIVE MEMBERSHIP.

Applications for membership, with remittance of regular membership fee, have been received as below since the annual meeting at Niagara Falls:

Adams, Fred J., Grand Rapids, Mich.
Ainsworth, C. E., Sault Ste Marie, Mich.
American Fish Culture Co., Carolina, R. I.
Boyce, Frederick C., Carson City, Nevada.
Bullard, C. G., Kalamazoo, Mich.
Chambers, Arthur E., Kalamazoo, Mich.
Dunlap, Irving H., U. S. Fish Com., Washington, D. C.
Green, Myron, Franklin, Vt.
Hubbard, Waldo F., Nashau, N. H.
Jensen, Peter, Escanaba, Mich.
Lambkin, J. Bayard, Cape Vincent, N. Y.
Locke, E. F., Wood's Hole, Mass.
Mead, A. D., Brown University, Providence, R. I.
Seagle, Geo. A., Wytheville, Va.
Smith, Dr. Hugh M., U. S. Fish Com., Washington, D. C.
Starr, Wm. J., Eau Claire, Wis.
Thompson, W. T., Nashau, N. H.
Tucker, Edmund St. George, Halifax, N. S.
Vincent, W. S., Leadville, Colo.
Vogelsang, Alexander T., Mills Building, San Francisco, Cal.

The active and prospective membership lists as revised and brought down to October 15, 1899, include 204 names.

HONORARY.

The President of the United States.
The Governors of the several States.
Borodine, Nicholas, Delegate of the Russian Association of Pisciculture and Fisheries, Uralsk, Russia.
Mather, Fred, Lake Nebagomain, Wis.
Southside Sportsmen's Club, Oakdale, L. I., N. Y.
New York Association for the Protection of Fish and Game, New York City.

Lake St. Clair Shooting & Fishing Club, Detroit, Mich.
Woodmont Rod and Gun Club, Washington, D. C.
Fish Protective Association of Eastern Pennsylvania, 1020 Arch st., Philadelphia, Pa.

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, Viborg, 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.
Macleay, 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.

Division of Fishes,
U. S. National Museum

TRANSACTIONS

American Fisheries Society

NINETEEN-HUNDRED

Smithsonian Institution
National Museum

Division of Fishes,
U. S. National Museum

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.

FRANK N. CLARK, *Chairman*, Northville, Mich.

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.

INDEX.

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 Secretary 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 receive 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 havê 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 *boskaminasagon 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.

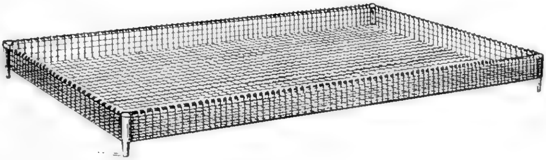

FIG. 1

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

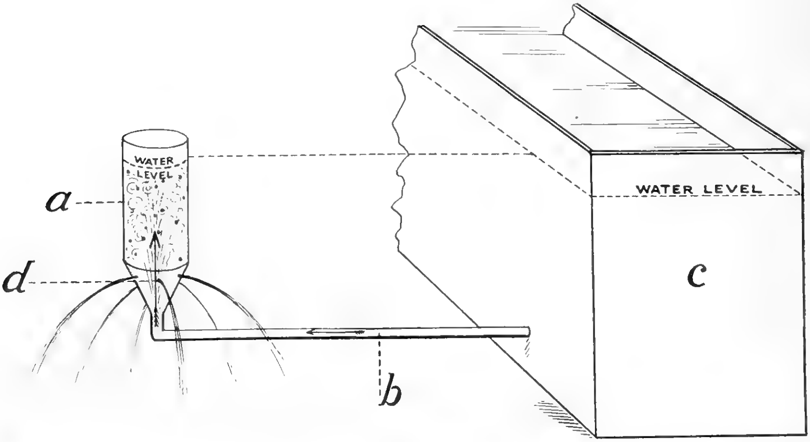

FIG. 2

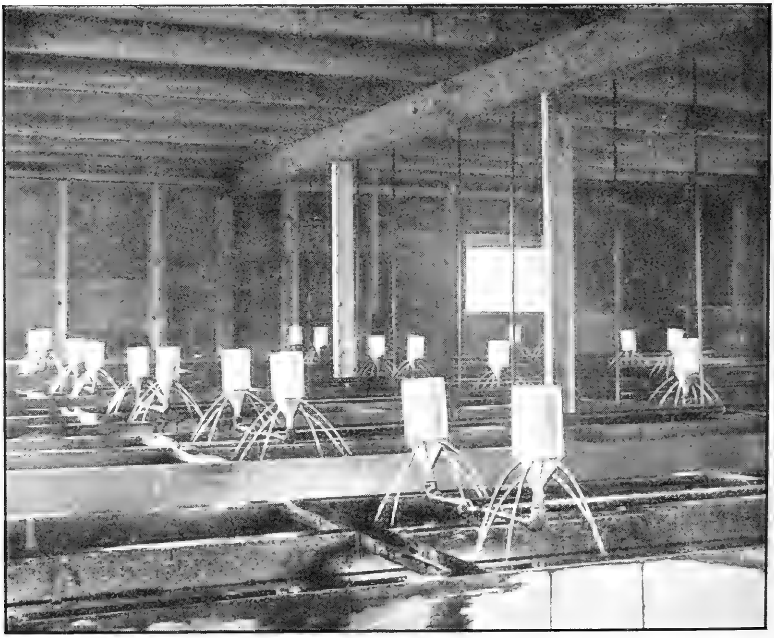

FIG. 3

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.

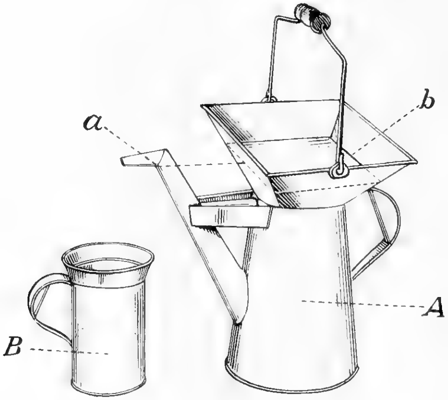

FIG. 4

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.

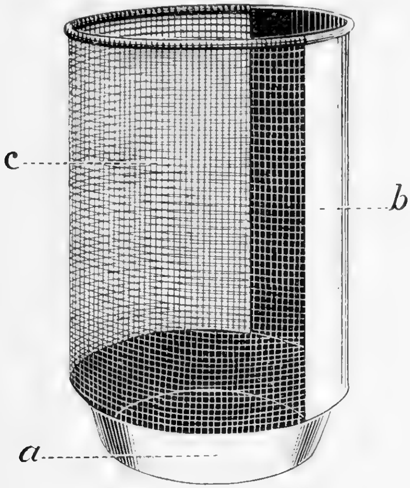

Fig. 5

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.

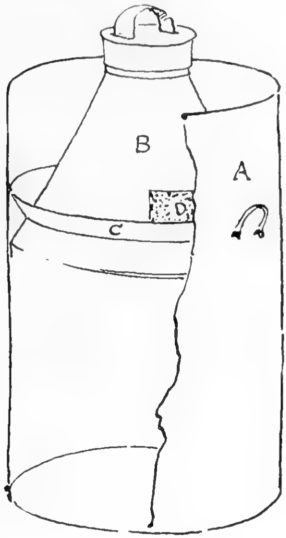

FIG. 6

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

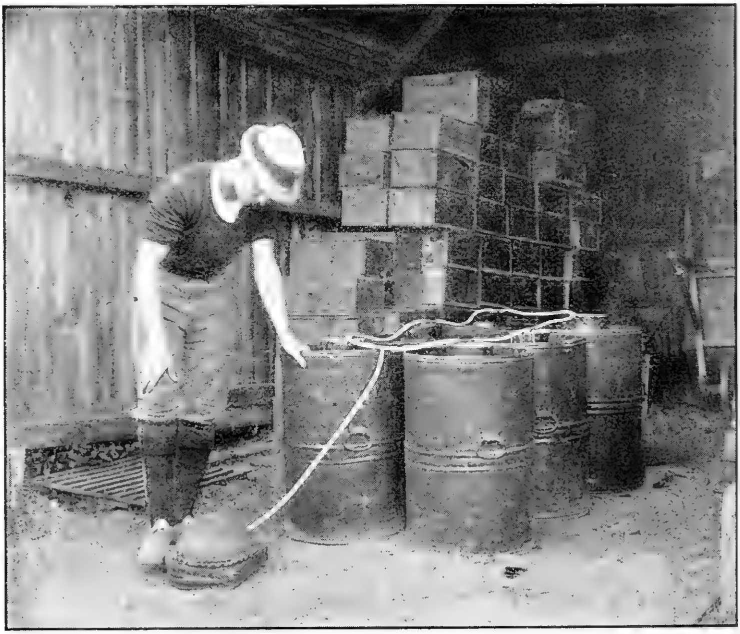

FIG. 7

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 inland 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 everything 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 introduction 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	13,206	43,280	18,500	12,061	28,000
Bath	100,000	100,C00	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	49,000	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 185,938,000 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 downward 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 undertaking 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.

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*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 difficult 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 predictions 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 unmolested 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 aereation 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 aeration 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 millions 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 dedegrees. 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 percentage 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 rifiles 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 FREE-TOWN 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

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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.

LIST OF MEMBERS.

ACTIVE.

Adams, E. W., 114 Wall st., New York.
Adams, Fred J., Grand Rapids, Mich.
Ainsworth, C. E., Sault Ste. Marie, Mich.
Allen, G. R., Roxbury, Vt.
Alexander, George L., Grayling, Mich.
Alexander, L. D., 50 Broadway, New York.
Anderson, J. F., 240 Eleventh st., Jersey City, N. J.
Andrews, A., Columbus, Ga.
Annin, James, Jr., Caledonia, N. Y.
Atkins, Chas. G., East Orland, Me.
Ayer, F. W., Bangor, Me.

Babbitt, A. C., Williamsburg, Mich.
Bailey, H. W., Newbury, Vt.
Ball, E. M., Leadville,, Colo.
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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.
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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.

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